SCHOOL AND HOME GARDENING

KARY C. DAVIS

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Portion of home school garden club market, Lincoln, Nebraska. Children, parents and business men are pleased with it. Garden supervisors in the foreground. Two assistants also in booths. (C. W. Watson, Supervisor, Lincoln.)

SCHOOL AND HOME GARDENING

A TEXT BOOK FOR YOUNG PEOPLE, WITH PLANS, SUGGESTIONS AND HELPS FOR TEACHERS, CLUB LEADERS AND ORGANIZERS

BY

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PREFACE

The author has tried to make this little volume so full of useful hints and practical instruction for young people, teachers, and parents, that it will lead to the making of many good home gardens in both city and country.

The school garden movement should have for its main object the starting of home gardens by both young and old. All other objects of school gardening, as herein enumerated, should be given a trend towards this one great aim.

In this volume many simple home and school exercises are briefly outlined, for the purpose of developing the underlying principles. It will be found that the trial of these exercises will develop much thought in the young mind, and a greater interest will be maintained.

Suggestions to teachers and club leaders are given in Part III. The first two chapters of the book should also be read by leaders in the garden work.

Beginners will find the garden calendars and planting tables very helpful. The illustrations have been chosen chiefly for instruction and suggestion rather than for mere interest.

K. C. Davis.

December, 1917.

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Miss Caro Miller, Supervisor of School Gardens, Philadelphia Schools, has given numerous suggestions incorporated throughout the book. Similar suggestions covering the entire book have been given by S. B. McCready, Director Elementary Agricultural Education, Ontario Agricultural College, Guelph, Canada, and by E. E. Balcomb, Professor of Rural and Agricultural Education, State Normal, Greensboro, N. C.

Helpful suggestions on their respective chapters were given as follows:

T. C. Johnson, Director Virginia Truck Station, chapters on Plant Growth, and those relating to Insects, Diseases and Spraying.

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J. L. Randall, Garden Specialist, U. S. Bureau of Education, Southern Garden Calendar.

George I. Christie, Corn Specialist and Director, Indiana Station, chapter on Corn.

R. L. Watts, Dean Pennsylvania State College, the Garden Calendar for Northern States.

John W. Lloyd, Professor of Vegetable Gardening, University of Illinois, the matter relating to the growing of vegetables.

Albert Dickens, Professor of Horticulture, Kansas Agricultural College, the chapters on Irrigation and Drainage and Experiments with Soils.

A number of the drawings are by Mrs. Kary C. Davis, and she has aided in the gathering of materials, reading manuscript and proof.

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PART I

OUTLOOK TO GARDENING

CHAPTER I

BEGINNINGS AND AIMS

Historical.—It is difficult to discover the first effort to introduce elementary school gardening into the United States, but it probably was made by the Massachusetts Horticultural Society. In 1890 Mr. H. L. Clapp, of Roxbury, was sent by this society to Europe to make a study of school gardens in Germany, Belgium, England, France, and elsewhere. As a result of his investigation, Mr. Clapp started a school garden at his own school the next year.

From this small beginning has grown the strong belief that *children of all schools* should, if possible, be given some helpful instruction in the use of their natural surroundings, which will give them both pleasure and profit. That this can be accomplished through school gardens has since been well demonstrated in hundreds, even thousands, of schools in America.

Boston and Detroit both made early use of school gardens to train children. Cleveland and Philadelphia followed very promptly. Minneapolis and New York City should both be credited with the introduction of many new features.

The pioneer work along this line in Dayton, Ohio, was started in the schools and among the boys of the city through the efforts of the president of the National Cash Register Company. This began in 1897.

Under a scheme which has taken the name of its first supporters and become known as the *Macdonald Movement*, the first systematic plan for the establishment of school gardens in connection with rural schools in America was started in Canada by the Macdonald funds. School gardens were officially encouraged by the provincial Department of Education and were made a part of the Provincial system of education and in some provinces grew in favor.

Normal schools, and colleges in all sections are now training teachers to carry on this kind of work in connection with other subjects of the school. School gardens, or home gardens by school pupils, are now organized in every part of the land. That school gardening is a suitable part of the well-planned school training for young people is now universally recognized. Much credit is due to those pioneers who have brought this condition of affairs about in the American systems of education.[1]

Character of the Instruction.—The instruction in the earliest school gardens varied widely in its character, each following one or more of the following lines:

1. In some there were penny packets of seeds distributed to children of the schools in the spring. These were to be planted at home and the products exhibited at the school in the fall. Little or no supervision was given the gardens by any instructor. Penny packets for school children are now supplied by several dealers and associations of the country.

2. More or less permanent home gardens, under direction of supervisors and employed gardeners to give personal instruction. These might be with or without hotbeds and coldframes.

3. Vacant lot gardening, in congested sections of large cities. See next chapter.

[1] For further mention of the early development of school gardening, reference is made to Chapter I, "Among School Gardens," by M. Louise Green.

4. Roof gardening and window gardening, where larger garden plots could not be obtained.

5. Large gardens, suitably located where pupils from different parts of the city were sent on certain days of the week. Instruction was given by young people or gardeners trained for the particular purpose.

6. One of the best plans was to establish a school garden at or near each school building. Each pupil was then allowed to have an individual row or plot in the garden. The instruction was given either by the regular school teacher or by a special teacher.

Of all these plans worked out in different places by the pioneers in this movement for better school training, the last (6) is most ideal, but the various other plans suited the varied conditions found about the schools which undertook the work.

Supervised home gardens are now systematically conducted in a number of places. The supervisor may be either (1) a special instructor devoting his entire time to the work, or (2) a market gardener giving some spare time to help the home gardeners, or (3) a teacher giving part time to other work in the schools.

OBJECTS OF YOUNG PEOPLE'S GARDENS

Those who began the work of organizing the early school gardens had in view a number of purposes. All or nearly all of these purposes should be kept in mind by teachers, parents, and other leaders in the school garden movement.

The garden work trains the mind, the will, the affections, the body; yes, and the morals.

In Dayton, Ohio, the leader was impressed with the valuable training given to boys who had chores or regular duties to perform. The garden furnishes the child such regular work and develops the sense of responsibility. In some schools the garden work is "required" just as other subjects are.

The effect of the school garden, when offered to children of a city, is to take them off the streets, away from bad surroundings, and give them a most wholesome environment.

The effect of the garden in the country is to fill the mind of the child with thoughts which are elevating and not degrading. Idle hands and leisure hours are as bad for country children as for others. The wholesome refinement of the garden fills the place of vulgar twaddle. Country children learn to love their future life occupation. They find it has a scientific foundation.

The dullest or most backward pupils become aroused and interested when given work in the garden, and other school work basod on what has taken place in the garden is done with renewed interest. They become more regular in attendance. The discipline and moral tone of the school are improved.

Children become interested because they are to accomplish something definite, and the training becomes concrete instead of abstract.

Because of the aroused interest on the part of the pupils, the gardening takes away much of the school drudgery even from the teacher. Teacher and pupils alike feel the renewed interest and inspiration from the new point of view of the school and its work.

Schools giving a few hours a week to gardening find their pupils excel in other studies when brought in competition with schools without gardening. This is the best proof that gardening aids the other work of the school.

The school garden gives a relaxation from the wearisome duties of the classroom, and keeps up the child's interest in the whole school work. It furnishes a basis for the other lines of work. It puts into concrete form many of the problems in arithmetic, the lessons in reading, the language "stories" or essays (see Chapter XXII).

The nature study work of the city school is made most practical when based upon the garden. The child is led gradually from the known to the unknown.

In the garden the powers of observation are developed properly—" turned into orderly channels of cause and effect." The child's mind is freed " from the power of sensory illusions and his moral nature from superstitions."

The economic and useful side of the garden training comes intuitively. Many children and parents first think of the use which the garden can be in reducing the grocery bills. It teaches how to live, not merely how to get ready to live. Teachers need not stifle that thought, nor need not emphasize it. The garden work may also develop the æsthetic and sociological sides of the child's life. The seeing of things beautiful and excellent in nature and art is itself a potent factor for good.

School gardening often changes the attitude of children toward the school building and its surroundings. Desolate places are made beautiful. Defiled buildings are cleaned and easily kept clean. Littered grounds are cleaned up and kept in order.

Work of this character arouses a community spirit. A true feeling of public interest and care of public property is engendered.

The improvement of the school surroundings through gardening work soon reacts upon the homes of the pupils. They are made more beautiful and attractive. In home yards neatness often takes the place of squalor.

When associated with schools having manual training for children, the garden work completes the field of industrial training. It rapidly develops habits of accuracy and powers of initiative. Where manual training is not possible the garden will amply take its place, as it causes more and better development than when manual training only is given.

Gardening is found to be one of the best lines of training for young people in reform schools. But public school children should be given the benefits of gardening and thus avoid the possible need of sending the unruly ones to reform schools.

The school garden system in Canada "aims at helping the rural population to understand better what education is and what it aims at for them and their children." The garden work is "designed to encourage the cultivation of the soil as an ideal life work," but incidentally gives to the child a "symmetrical education," as it gives suitable "scientific information and the habit of careful observation."

In France the object is not to teach farming but to develop in children the natural interest in flowers, birds and growing

Fig. 1.—Produce from one child's plot in one season. Fairview school, Yonkers, N. Y. (School Garden Association of America.)

things, and inspire a love for the country. But the instructors give a knowledge of the soil, means of improving it, methods of cultivation, and the management of a garden.

"The main object of the study (in Switzerland) is to train to better mental grasp by developing the power of observation, the skilful use of the finer muscles of the hands. The useful information is incidental, though it appears otherwise to the child and often to the parent."[2]

In many schools in America the products of the garden are of no insignificant consideration, particularly in the minds of the children. The crops are often used for canning by

[2] M. Louise Greene, "Among School Gardens," page 13.

members of canning clubs. One interest in the garden work may, therefore, be the production of crops for some definite purpose (Fig. 1).

Home gardening and vacant lot gardening are often conducted with the products as the chief aim. But this does not weaken nor destroy the many other objects of children's gardens. A good example of the pursuit of gardening for the money returns is found in Lincoln, Nebraska, where a children's market was established in the summer of 1916. The sales in this market on the Saturdays of June and July totalled $338. Such returns greatly increased the interest in the garden work (see frontispiece).

The School Center.—Children's garden work should center about the school. Teachers should start it whether it be school gardening or home gardening. If there is a suitable place available for a school garden let that be started first. Then let the pupils start gardens at home also.

The home gardens may be encouraged by starting competitions in the growing of vegetables, flowers, corn, potatoes and other crops. Exhibits to be held in the fall may be announced and planned in early spring. Perhaps prizes may be offered. Such contests will help to keep up the interest in both the home garden and the school garden through the whole summer. Let the exhibits be held at the school. Perhaps a program my be offered in connection with the exhibit. In some cases it may be well to charge a small admission at the time the program is given.

Garden exhibits may well be held in combination with exhibits of manual training, sewing, cooking, drawing, penmanship, and other lines of school work. The more correlation at such a time the better (see Chapter XXI).

Garden clubs, including school children and others, may be started by teachers. The school will become more and more the community center for such interests (see Chapter XXI).

Vacation Time.—If the work is well started and the interest thoroughly aroused before schools close for summer vacation, the gardens will be much better taken care of. The care of the school garden during summer vacation should be assigned to some few students or to a janitor or to a committee or to a neighbor appointed for the purpose. In some cases each pupil will faithfully take care of his own portion of the school garden during vacation; but too frequently this plan fails.

The garden crops that mature during vacation will furnish compensation to the persons who care for the whole garden.

Whether there be a good school garden or not, it is always possible to plan some good vacation gardens for the pupils to use. These should be planted either at home or, for city children, vacant lots may be used. Let the planting be done at the proper times in the spring while school is in session and have reports made from time to time.

School Teachers the Best Leaders.—Any teacher, with a desire to help the school and the young people of the community, will succeed better in the garden work than a professional gardener. It is not at all necessary to hire a gardener for the purpose. The suggestions and advice of such persons are often helpful, but the teacher will have to adapt the suggestions to the school conditions.

The trained teacher can work out the plans and carry on the work better than any one else. The teacher is in sympathy with the child's mind and understands his point of view. Together they will overcome all difficulties and make the garden a success (see Chapter XXIII).

THE GARDEN

(Arthur Wallace Peach in *Orange Judd Farmer*)

Calm in the winter hush it lay asleep
Beneath a downy coverlet of snow;
I saw the twilight shadows o'er it creep,
And heard the storm winds shouting to and fro.

The moonlight touched it with a beauty white,
  But still it slept a long, sweet sleep of peace;
It gave no heed to voices of the night,
  Nor asked from its deep slumber quick release.

Yet in my heart I wondered if it dreamed
  As I, of coming days when it should hear
The southwind call, and see as sunshine gleamed
  Across the hills, the wide earth wake with cheer.

Now dreams come true; it hears the southwind's voice;
  It wakes from sleep and dons its gown of green.
Birds down its paths with early songs rejoice;
  And sunbeams for their springtime dance convene.

Soon shall it rise in beauty crowned with flow'rs,
  And to our hearts a joyous rapture bring;
It casts away the gloom of wintry hours,
  And wears the hues and splendors of the spring!

Opinions of Teachers.—The following statements are chiefly from rural teachers whose initials are given:

School gardening arouses interest, and may be made the means of keeping boys and girls in school.—C. O. B.

It helps in all other branches of the work.—B. W. H.

It helps the children in all branches of study.—M. E. W.

The attendance is much better.—N. S.

It teaches growth of plants, and farming or gardening can be learned easily. Instead of being degrading, it is elevating.—R. B. H.

Gives the child a means of understanding the life around him, so that life means more to him than to a child who never realizes his relation to nature and his dependence on plant and animal life.—B. M. B.

School gardening may be correlated with all other subjects taught in the school. It is therefore a good study to introduce early to enrich the other work.—A. M. L.

A school garden teaches the children to become interested in rural life, and gives them a practical interest in their other studies.—A. M. T.

The school garden is something that the child can see and enter into fully; so it interests him and makes him love school more.—L. C.

School gardening is necessary in that it teaches a child to know something of the economy of space and respect for individual ownership.—M. G. T.

A school garden helps to quicken interest in most of the other subjects, and gives the children practical information on everyday things.—S. F. C.

School gardens are of real practical value in training for life.—B. E. K.

It awakens the interest of the children, and thereby they gain much useful knowledge, and in addition learn to observe closely.—M. J. R.

School gardening should be so conducted that practical knowledge and experience are gained, crops of real worth and best quality raised, and each child stimulated to go out into the world and do likewise.

School gardening should be so taught that each child feels the wonder yet the perfect naturalness of life in all its phases; in plants and men alike.

In rural communities the garden work should teach best methods and the underlying principles; it should interest the child to stay on the farm. In the cities children should be taught the money possibilities of a small plot of ground,—the practical side is to be developed as well as the ideal and the spiritual.—C. M.

The home garden should be the result of every school garden.—M.

CHAPTER II

VACANT LOT GARDENING FOR VILLAGES AND CITIES

THE use of vacant tracts, either large or small, in villages and cities, for gardening purposes should be encouraged by all. It is to the interest of the owners of such lots, as well as to the users, to have them cultivated for garden purposes. Lots or tracts thus used are made more beautiful and more salable. The gardens raised on them return a profit to the persons doing the work. Much pleasure is gained and healthful employment is furnished to those who might otherwise be out of employment a part or all of the time.

Historical.—In the early nineties Mayor Pingree of Detroit found many of the Detroit workingmen out of employment. He noticed the numerous tracts of vacant land which were "eyesores" to visitors and others. Many of these lots were dumping grounds where tin cans, garbage and other wastes were scattered. Flies and mosquitoes found breeding places, and the health of the city was greatly impaired.

The mayor started a movement which led to the use of thousands of vacant lots for the growing of potatoes and other garden crops. The suburbs of the city were made beautiful. The lots were cleaned up and plowed. Crops were planted. Idle men, women and children found employment. Crops were produced which aided materially in the maintenance of many poor families. Hundreds, who had been dependent upon the city for support, became independent. They were able to look the world in the face, as they were no longer beggars.

Other large cities have, from time to time, taken up this movement and with slight changes have carried out the plan started in Detroit (Figs. 2 and 3). In some cities the plan has been to follow the vacant lot gardening only during

Fig. 2.

Fig. 3.

Fig. 2.—Preparing a waste lot for gardening. Cleveland. (Cleveland Home Garden Association.)

Fig. 3.—The same lot made into a good garden by two boys. (Cleveland Home Garden Association.)

"hard times," when other forms of employment were difficult to find. In still other cities the plan has been to supply the tracts to those in most need of this form of help. Poor families, or persons having poor health, or families where a number of children are most in need of employment, are furnished with tracts to cultivate.

The Philadelphia Vacant Lots Cultivation Association in 1913 reported 544 families using gardens assigned to them, averaging about one-sixth of an acre. This used practically all of the idle land available for the purpose. In one year the expense was $4000 and $25,000 worth of vegetables was produced. In Baltimore the committee required gardeners to pay a fee of one dollar a year each for their plots. There, as elsewhere, a trained person is employed to oversee the gardening operations.

A few of the things accomplished by the Minneapolis Garden Club in 1911 were: "Every vacant lot for two miles along one of the principal arteries of the city was beautiful. The first census of dirty vacant lots ever taken in the city was made and with the coöperation of the Improvement Society 600 acres were cleaned of rubbish. Ash heaps and dump piles disappeared; bill board lots were cleaned, levelled and sown to rye. Former vacant lots become productive gardens. As many as 1800 persons had home gardens, and it is estimated that 1000 homes were improved through enthusiasm created by gardening activities on school property and vacant lots. The gardening fever spread like a contagion all over the city —not only the gardeneng fever but the cleaning-up fever. In fact, cleanliness was the keynote of the Garden Club scheme."

Plan of Work.—An association or club is first organized for the purpose of starting the vacant lot gardening. Some public interest must be aroused by articles in local papers and by lectures given by persons from cities where the work has been done.

The ownership of vacant tracts must be found and the use of the land solicited. This is done with little cost, and nothing is paid to the owner of the land for the use of it. An agreement may be made with the owner that he may sell the land or use it for building purposes at any time. This seldom if ever results in the destruction of a growing crop.

In some cases a little measuring or surveying is necessary to establish the lines, and to divide large tracts into individual gardens. After sufficient land is thus made available, application blanks should be published in the local press so that all who are in any way interested in doing the garden work may have an opportunity of applying for a garden tract. The plans may be explained to all teachers in the public schools, and they may tell the pupils about them.

The applications may be examined by a committee appointed for the purpose. The assignments, if necessary, may be made to those persons who seem most in earnest or who would be most benefited by the use of such gardens. Another plan is to make assignments in the same order that applications are received.

Aid to Gardeners.—In most instances the cleaning up is done by the association, and a fence, if necessary, is placed around each large tract. A fence is usually not necessary, but may be needed where stock are allowed to roam or where paths have been formed by neighbors in the vicinity. The fence may be of a temporary character and inexpensive—perhaps a single wire three feet from the ground fastened on stakes about one rod apart.

Tracts which have not been in use for gardening purposes should be plowed some weeks or months in advance, and kept harrowed to prevent the growth of grass and weeds. Just before planting time the ground may be cultivated or disked to make it mellow for planting. This plan is not always possible, as it is much more expensive where teams are to be hired.

The association grows plants in its own greenhouse or hotbeds, or may purchase them at wholesale for the members. Thus the gardeners are supplied with an assortment of such plants as tomato, cabbage, cauliflower, pepper, egg-plant, and others at nominal cost.

Seeds in any desired amount and of all kinds are supplied from local distributing stations, at actual cost. Manures and fertilizers are applied to the land in the spring by use of teams and wagons employed by the Association.

Instruction.—Some person well informed as to practical methods of gardening is employed to give instruction to the gardeners. This is done both in the garden and by circular letters sent by mail.

The Superintendent.—It is essential that a good superintendent have the entire work in charge. He should understand not only the best ways of securing land and preparing it for use, but shculd have the knowledge and instincts of a gardener and know how to impart this to others. He should understand how to make the best use of the public press, and how to interest various local organizations and officials.

He should be a good lecturer and understand lecturing with lantern slides. He will need to have occasional meetings with the gardeners, and give them instruction along certain lines by means of pictures, as well as orally. The use of lantern slides in public lectures will aid much in arousing public interest in the work.

Funds for the Work.—The gardens are supplied to members free, and materials, such as seeds, plants, fencing and manure, are not entirely paid for by the gardeners. A fund must be raised to defray the numerous expenses of the association, such as salary of the superintendent and assistants, labor in clearing lots, hire of teams and men in plowing, and applying fertilizers, the purchase or hire of implements, rent of office or garden headquarters, typewriting, telephone, postage, printing and other incidentals.

It is often necessary and perhaps well to charge each gardener a small fee for plants, seeds and fertilizers. This plan helps to exclude applications from those having too much ambition at first and too little persistence later on. The payment of a small fee aids in maintaining the interest of the younger gardeners, particularly at times of greatest discouragement. The fee may be $1 the first year, $2 the second year, $3 the third year, $4 the fourth year and $5 for each succeeding year. Preference should always be given to former users of each garden plot when the assignments are made. The prospect of being re-assigned the same garden the following season induces the gardener to keep down weeds, put the land in better condition, become familiar with its needs, and use winter cover crops or grow winter products.

Contributions for prizes to be awarded to those most successful in different lines of garden work are easily secured from citizens interested in the work. An exhibition held at the close of each season may be the source of raising funds, by the sale of admission tickets. Funds are often supplied by park commissioners, boards of trade, city councils, factory companies, improvement associations, and philanthropic citizens.

Good and Bad Charity.—It is usually considered bad charity to give money to able-bodied people to aid in their support. A much better form of charity is to provide conditions whereby such persons may aid themselves. The Vacant Lot Gardening Association says to any such person: "Do for yourself," "Be a man," "You have muscles, you have arms, use them." The Association provides the means whereby such effort on the part of poor people may be applied by them to their own support.

This form of charity gives better results than any other. Instead of supporting the poor and down-trodden in a state of idleness, which encourages pauperism, they are shown how to support themselves, or to aid in their own support. They are given employment in the free, open air, away from the channels of vice and crime.

Circular to Prospective Gardeners.—The following wording was incorporated in a small leaflet sent to the prospective workers in the Philadelphia vacant lot gardens:

Opportunity.—Are your wages large enough to enable you to buy all the things you need for yourself and family? Or do you find that the cost of food, clothing, rent, etc., necessary to properly maintain yourself and family, is so high that you cannot make your dollars go as far as they should? Hundreds of families in Philadelphia have found a big aid in meeting this difficulty by working.

Vacant Lot Gardens.—Has your health been poor? Have you therefore been prevented from working as you otherwise could and would like to? Many invalids, including those who have tuberculosis, have found great improvement in health, while at the same time producing needed supplies in the healthful open-air work on *vacant lot gardens.*

Are you among those who have reached an age which prevents you from competing with the younger ones in the rush of modern working methods? Many old men and women, some over eighty years of age, have kept in good health while producing a great deal for their own support on *vacant lot gardens.*

If for any reason you need a *vacant lot garden* write at once to the Superintendent.

Our Method.—Our Association has made arrangements with owners of various wasting tracts of idle land, which afford a splendid opportunity for cultivating in different parts of the city, to use this land for *vacant lot gardens* until the land is needed for building or other purposes.

Our Association prepares the land, plows and harrows it (and fertilizes it when necessary) and divides it into gardens, generally about one-eighth of an acre in size. These gardens are then assigned to various persons or families, who have made application, in the order in which the applications have been received. Therefore, you will see that if you want to be sure to get a garden, you should send your application now.

With each garden our Association distributes an assortment of good seeds and plants, sufficient in quantity for a good start. This assortment is generally about as follows: 1 basket seed potatoes, 1 quart lima beans, 1 quart string beans, 1 quart butter beans, 1 pint corn, 1 quart peas, 2 ounces beet seed, 2 ounces radish seed, several dozen tomato and cabbage plants.

As the Association secures the land free of charge, it assigns the gardens on similar terms without charge for their use but charges $1 towards the expense of plowing, seeds, etc., which cost the Association about $5 a garden. If a person or family cultivates a garden properly one season, the Association generally re-assigns the garden to them the following season if they desire it. Two dollars is charged the second season for the plowing, seeds, etc., $3 the third season, $4 the fourth season and $5 the fifth year. However, those who take a garden the third season may, if they desire, furnish their own seed instead of taking any from the Association, in which case they would be charged only $2.50 for the plowing and fertilizing.

A Form of Vacation Gardening.—When the city schools close, hundreds of children are turned out upon the streets.

FIG. 4.—Vacant land gardening in Portland, Oregon, supervised by public school teachers. (Photo from Children's Flower Mission, Cleveland.)

Usually no provision is made for the employment of their time in play or work. Idleness leads to mischief. Too frequently the good influences of home, school and church are overcome by bad associations. This is always worse during vacation seasons.

Vacant lot gardening offers one of the very best forms of supplying vacation employment to both girls and boys of school age.

They may work with their parents and friends under the direction of the garden association. When the schools close for the long summer vacation, the school children can spend much of their time in the gardens (Fig. 4).

The instruction given in the garden work by the Association is of life-long value to such young people. They enjoy the work and usually seek the opportunities offered by the association.

Appreciation of the beautiful should be instilled in the minds of young people. This takes the place of training of the opposite kind, where vacant lots are unimproved, too often given to young people. It is because of the improved appearance given to the city that park commissioners find it advisable to aid vacant lot gardening projects.

FIG. 5.—Back yard gardening by a poor boy.

When young people supply a part of the vegetables for the family table they early learn the value of honest effort and a sense of responsibility. In poor families, the children learn the possibility of aiding their parents in making a living for the family, through work which they greatly enjoy.

Home Gardening Encouraged.—The spirit of gardening rapidly spreads from the vacant lot tracts to the back yards of the people living in the neighborhood (Figs. 5, 6, and 7). The cleaning-up spirit pervades all. Many cottagers who have never done any gardening before learn the methods by seeing what others accomplish. They not only learn from observation, but realize the benefits, pleasures and profits to be gained

FIG. 6.

FIG. 7.

FIG. 6.—His first garden and one of the first in his neighborhood.
FIG. 7.—The garden is all her own, but she is glad to furnish produce for the family table.

from gardening. The back yard garden is soon established, and is maintained forever. Hundreds of such gardens are found in neighborhoods where the Association has established gardens. In 1912 there were six thousand home gardens supervised by those in charge of the school garden system in Philadelphia. This plan of supervising the vacation gardening of the school children is found in a number of cities.

Speaking of the back yard gardens in Baltimore, *The Sun,* of that city, says: "Some are veritable beauty spots created in places that were once eyesores. In the weary stretch of brick and stone, when you come upon such a bower of trees and flowers and greenery it looks like an oasis—as refreshing as a flowing well in a dry and thirsty land. And the movement is only well begun. The yards that have been improved are such a pleasure to their possessors that the wonder is all the neighbors do not follow their example. There is nothing that will give richer returns for such a small investment of time and money."

Health of the City.—Not only is gardening a healthful occupation for the individual doing the work, but the effect of vacant lot gardening is to make the whole city more healthful. Garbage heaps are breeding places for flies. Disease is spread from places of accumulated filth by myriads of insects which breed there.

Mosquitoes breed in tin cans and pools filled with rainwater. Malaria and other diseases are spread by mosquitoes.

Cleaning up vacant lots by the burying of garbage, the removal of tin cans and the filling of low places prevents diseases common during the summer season (Figs. 8 and 9).

Vacant lot gardening has resulted in the reduction of malaria, typhoid fever, and dysentery. If the facts could be known, it has doubtless provided a check for tuberculosis and other germ diseases.

Thus money and effort spent in the cleaning up of vacant tracts and the establishment of gardens not only results in benefit to those actually engaged in the work, but has advantages of a more universal nature (Fig. 10). It is better to spend money in the prevention of disease than in the cure of

Fig. 8.

Fig. 9

Fig. 10.

Fig. 8.—An unsightly dumping ground, and a menace to health. (Cleveland Home Garden Association.)

Fig. 9.—The same ground made into a productive garden. (Cleveland Home Garden Association.)

Fig. 10.—The whole neighborhood is interested in the improvement and the profits. (Cleveland Home Garden Association.)

it. Many physicians have testified to the good effects, both upon the individual and the city, of such garden work.

Criminality.—Hundreds of those who are engaged in the vacant lot gardening in various cities are people who would otherwise spend much time in loafing on the streets, or frequenting bad resorts. Their time is far better engaged in the garden work. Persons who have spent many nights in the city jails are lifted above such necessity or practice when they undertake the garden work. Better ways of gaining a livelihood are taught through gardening. Petty thieving is reduced. Begging is less common. There is always mischief for idle hands to do. A poor family when provided with a good garden will always be employed in a form of labor which is elevating and inspiring. This has not the pauperizing effect of charity, but encourages self-respect, self-dependence, better living, improved health, education and happiness.

The school garden is welcomed eagerly by the teachers of "special" classes—especially for the mentally and morally deficient. This work furnishes the finest kind of manual training, and has the advantage of being out-of-doors. School gardens have reformed many a chronic truant. When the call of the fields came to the city urchin he formerly ran away. Now, if he lives near a school garden, he answers the call there.

A Permanent Occupation.—Superintendents and others conducting the vacant lot garden work have observed many instances where gardening has become a permanent occupation as the result of a meager beginning. Many have moved to the suburbs or country to obtain larger tracts or small farms on which to follow gardening or other forms of agriculture (Fig. 11). They have become qualified to make a good living from an occupation which was before strange to them.

Instances are shown of persons whose condition of health was such as to make it impossible for them to continue with factory or other in-door employment, who made a good livelihood from gardening.

Gardening for All Classes.—Vacant lot gardening is not primarily intended for any one class of people; nor is it merely a form of charity. All classes engage in it. Those dependent upon charity may be benefited more than others, but the benefits are of so many forms that all classes are interested in the work. Children of self-supporting families; cripples needing out-door exercise; those affected with constitutional disease, and other invalids; old men and women; indeed whole families of all classes find different reasons for engaging in vacant lot

FIG. 11.—Work of the Playground Association of Pittsburgh, Pa. Gardening is as valuable as playing. (Children's Flower Mission.)

gardening. It may add to their health, to their happiness, or to their income.

The products may be used at home or sold to others in the neighborhood. In some families organized plans for producing and selling are found; the older members doing the work and producing the most intensive and valuable forms of garden products. The young members solicit orders and deliver the products. Imagine the change in feeling experienced by a widow with five children: she was formerly receiving money from the city, when by gardening she was able to support herself and family with no outside aid.

On one of the plots in the Baltimore alley tracts one gardener produced 218 quarts of tomatoes (canned), 15 baskets of tomatoes sold, 50 pints of chili sauce, 75 bottles of catsup, 90 quarts of corn, three pecks dried corn, four bushels dried lima beans, 200 dozen ears corn, 15 bushels early potatoes, with late ones to follow, 7 bushels beets, 1½ bushels onions, two bushels string beans, and a quantity of radishes, lettuce and early peas.

The importance of giving proper employment to those who need it, instead of trying to remedy the evils of idleness through other civic means, is illustrated by the following poem. It is better to give healthful, remunerative employment, such as gardening, to all, than to spend the money in supporting reformatories and houses of correction, or in trying to cure preventable diseases.

THE AMBULANCE DOWN IN THE VALLEY

Joseph Malins

'Twas a dangerous cliff, as they freely confessed,
  Though to walk near its crest was so pleasant;
But over its terrible edge there had slipped
  A duke and full many a peasant.
So the people said something would have to be done,
  But their projects did not at all tally.
Some, "Put a fence around the edge of the cliff,"
  Some, "An ambulance down in the valley."

But the cry for the ambulance carried the day,
  And it spread through the neighboring city;
A fence may be useful or not, it is true,
  But each heart became brimful of pity
For those who slipped over that dangerous cliff.
  And the dwellers in highway and alley
Gave pounds or gave pence, not to put up a fence,
  But an ambulance down in the valley.

Then an old sage remarked: "It's a marvel to me
That people give far more attention
To repairing results than to stopping the cause,
When they'd better aim at prevention.
Let us stop at its source all this mischief," cried he,
"Come, neighbors and friends, let us rally;
If the cliff we will fence, we might almost dispense
With the ambulance down in the valley."

"Oh, he's a fanatic," the other rejoined;
"Dispense with the ambulance? Never!
He'd dispense with all charities, too, if he could.
No, no, we'll support them forever!
Aren't we picking up folks just as fast as they fall?
And shall this man dictate to us? Shall he?
Why should people of sense stop to put up a fence,
While the ambulance works in the valley?"

PART II

GARDEN OPERATIONS AND EXERCISES

CHAPTER III

PLANNING THE GARDEN

Shape of Garden.—There are many ways of planning a school garden or a home garden. When there is an opportunity for choice in the matter of shape, let the garden be a rather long rectangle instead of square (Fig. 12). This gives more chance to use a plow in preparing the ground. The importance of this will be realized when the time arrives for spading up the soil for planting. Plowing is much easier than spading. The laborious work of spading the whole garden should be avoided if possible. In the larger gardens, plowing, harrowing and also cultivating between the rows may be done with horse power. Lay out the garden with such plans in mind.

Location.—Let the school garden be so located as to be as near the school building as possible, but do not let it interfere with the playgrounds. It is best to have a place for both garden and play.

In figures 13, 14, 15 and 16 good locations are suggested for small and for large grounds. In crowded cities, if the school grounds are too small for gardens, a vacant lot or several lots may be found near enough to be suitable for use (Fig. 17). If the garden can be all in one place, so much the better. The work of preparation and care are easier.

Protecting the Garden.—It is usually necessary to protect the school garden as well as the home garden. In the country a fence may be necessary to keep out chickens, cows or other animals; while in the city a fence suitable to turn

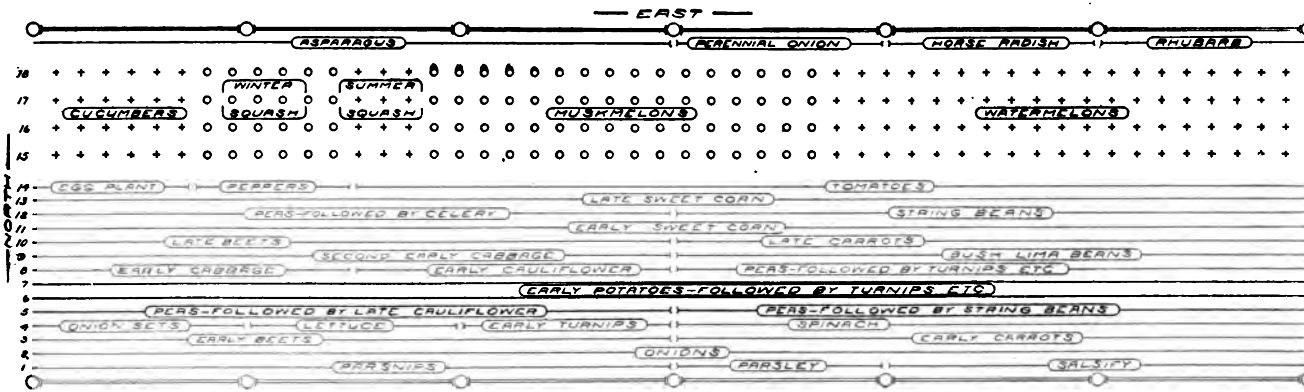


FIG. 12.—Plan for a home garden. (Pennsylvania Farmer, Philadelphia, Pa.)

away certain mischievous persons, as well as stray animals, may be necessary under some circumstances.

Fence.—One of the best forms of fencing is woven wire.

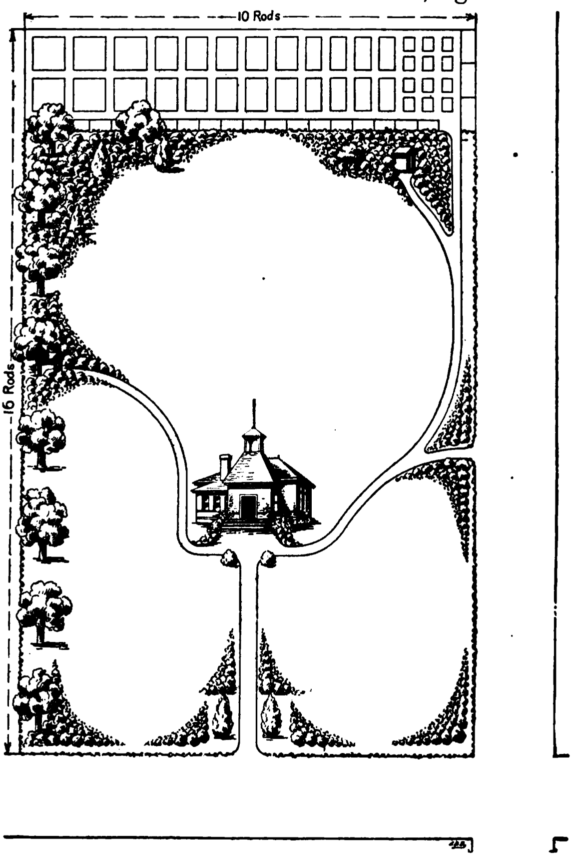


FIG. 13.—Plan for one-acre rural school grounds with the garden plots at the end opposite the main road. The grouping of shrubbery is suggestive. (U. S. D. A.)

It is easily put up and may be of any height and of any size of mesh desired. In the city a woven wire fence four or five feet high is satisfactory. To prevent people from climbing over it a line of barbed wire may be put along the top. Staple the woven wire to the outer side of the posts and staple the barbed wire along the inside of the posts. This will prevent unnecessary injury to any one.

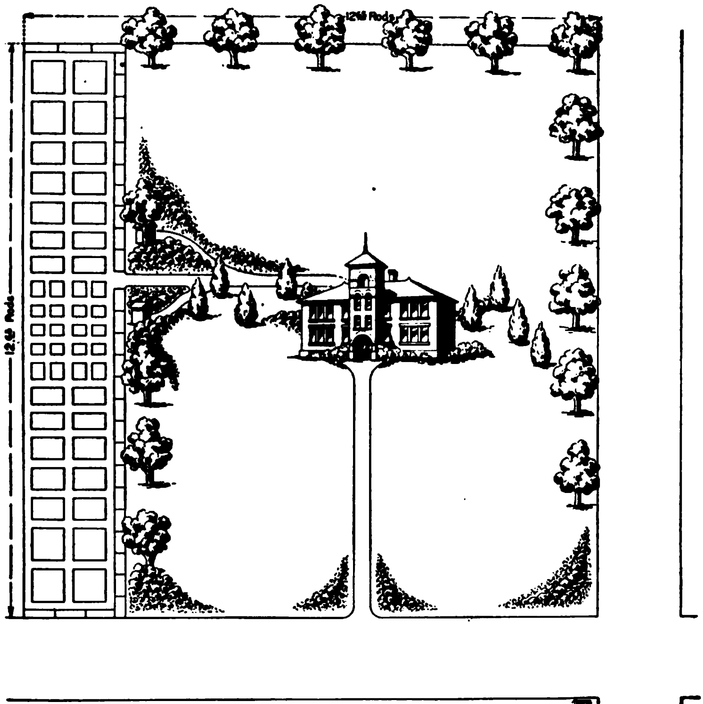


FIG. 14.—In planning the school garden large plots may be assigned to older pupils and small beds may be used by little people. (U. S. D. A.)

The light-weight woven wire, commonly called "chicken wire," may be satisfactory for some places. It is cheap but does not last so long as the heavier woven wire (see Chapter IV).

Hedges and Screens.—A suitable screen for a garden is often desirable. A border of shrubs may be planted in natural masses with good effect.

A well-kept garden is a pleasing sight, but a low hedge of some kind may be used to mark the line. Privet hedge, a line of roses, and Japanese barberry are all suitable marks for the garden line; these may be used either with or without a fence. As beauty is public property, low hedges are often best. The

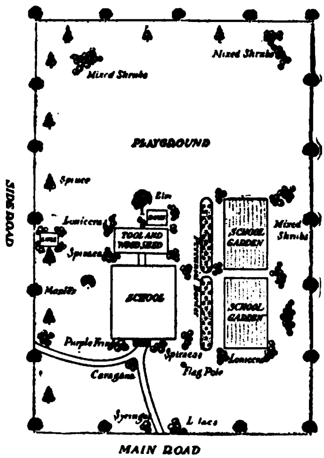


FIG. 15.

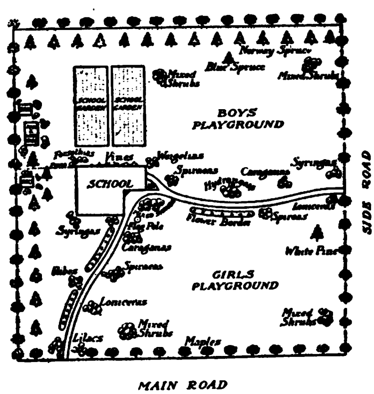


FIG. 16.

FIG. 15.—Planting plan for the improvement of rural school grounds. The gardens are not too near the roads, and the playground is at the back. (Arkansas Department Pub. Instruction.)

FIG. 16.—Plan for rural school grounds of two acres or more. The gardens are at the back. The grounds are well planted and yet room is left for playgrounds. (United States Bureau of Education.)

taller, dense, thorny hedges may be grown to take the place of a fence. Favorite plants for this purpose are: Common barberry, Osage orange, Japanese quince, Iboda privet, and the taller roses. Effective screens grown in the form of hedges may be formed of lilacs, althæas, dogwoods, and many other flowering shrubs.

Borders or hedges of densely planted evergreens, such as cedars, arbor vitæ, or spruces, are very attractive in both win-

and summer. Vines may be grown on the garden fence with pleasing effect. On woven wire fences we may use panicled clematis, Virginia clematis, grape-vines, hops, morning glories, cypress vine, flowering beans and others.

Laying off the Garden.—There are two common plans of laying off the school garden. Either plan is intended to give a certain portion to each pupil for preparation, planting, care, and harvest.

1. The older plan was to assign a small rectangular plot to

Fig. 18.—One of the Philadelphia Garden Association's beautifully cultivated garden farms, such as have proved of wonderful material benefit to hundreds of the poorer families. Note the rows are long,—few small beds. The toolhouses are small. (Children's Flower Mission.)

each pupil. These were made of the following dimensions in feet: 4 × 7, 4 × 10, 5 × 15, 6 × 8, 6 × 10, or other convenient sizes. There was a path left on the four sides to stand on while doing the work. The soil of these beds was heaped up much higher than the paths—an effect not pleasing to the eye because of the resemblance to a yard of graves. The heaping up of the soil causes it to dry out and suffer much from drouth. Another objection to this old plan is that it requires all the heavy and laborious work to be done by hand tools, instead of allowing the use of horse power, for the work is too heavy for small children.

2. The newer plan, now adopted by many schools, is to make the garden as long as possible and let the rows run the longest way of the garden, preferably north and south; then let each pupil have a row or a half-row or a smaller fraction as his own (Fig. 18). The distance between rows may be from two and a half to three and a half feet. If desired, one pupil may use the first few feet of several rows, the second pupil uses the next few feet of the same rows, and so on, until all the pupils are assigned a place (Fig. 17).

If the garden is long enough, this second plan allows the use of a horse to plow and pulverize the soil, and perhaps do the heaviest cultivation, particularly during the vacation season. A wheel hand hoe can also be used to better advantage.

In either of these plans of laying off the garden each pupil of a certain age or grade may plant the same things, so there will be a chance for comparison and competition. The second plan is usually preferable, because it teaches the methods to be used in the home garden.

Making a Chart.—After it has been determined which of the two above plans to use, the next thing is to make a planting chart. First let several pupils, working in pairs, measure off the grounds. If necessary, a tape line may be borrowed for this purpose, or two light poles or reeds may be marked off in feet and used for the measuring.

A map or chart may now be made on a large sheet of paper, using a scale of about one-eighth inch to the foot. Draw a straight line on the map for each line to be planted (Fig. 12); or mark off each rectangle on the map, if the "bed" plan of planting is to be followed.

Write on the lines the crops to be grown and how far each is to run along the row. Some power of initiative may be exercised by the older pupils in deciding what crops can be grown together, how much of each kind to grow, what ones mature quickly and what ones take a long time, the best season for planting and other important points.

A list of things to be grown may first be made on a blackboard and from this the pupils may each make a temporary plan, independently. The good features of each of the plans may be chosen to make up the permanent chart to be finally followed by all.

Location of Crops.—All kinds of perennial plants, whether shrubs or herbs, should be planted in those rows near the back or distant side of the garden. This will allow the remainder of the garden to be more thoroughly plowed or spaded in preparation for the annual crops grown from seed.

Rhubarb and asparagus are very good plants to have in a school garden, but they should be planted at the side of the garden where they will be undisturbed from year to year.

Place the long-season crops, as parsnips and salsify, near together. In like manner the quick-growing crops, such as lettuce and radishes, may be grown in their own section of the garden. If each pupil has his own row, he can plant quick-growing crops toward one end and the long-season crops toward the other end of the row.

On the map, mark what crops will be planted in the same part of the row together; for example, radishes with peas. Such are called companion crops (see Chapter XVI).

Succession of crops may be shown on the map by writing on the line plants which grow first, then those which will be planted next, as "radishes followed by beans," or "lettuce followed by cabbage," or "beets followed by turnips."

Flowers.—The teacher and pupils together should decide how much space to allow for flowers. It may be best to allow those who wish flowers in their gardens to have them and others may not be required to plant flowers.

A splendid growth of flowers along one or more borders of the garden will add much to the pleasure, interest, and value of the whole garden. Annual flowers may be planted in one part of the border and perennial flowers in another. It is a good plan to have a number of wild flowers from the woods planted in the perennial flower garden. A wild-flower garden is very inexpensive and a great source of benefit. From this may come a very wide knowledge of the wild flowers, and pupils learn to appreciate the rare beauties of real nature.

Fruits.—Schools which do not close before the time for strawberries to ripen will find this crop a good one to raise. Plan to set them in a good, sunny place and where the annual plowing of the garden will not disturb them. Other kinds of fruit which will mature in school season may be grown in the school garden.

The most serious objection to fruit growing in the school garden is the extra temptation the fruit offers to persons of a marauding disposition. Under circumstances where such an objection would be serious, the methods of starting and caring for a fruit garden may be considered in school, and the actual planting may be done at home.

Nurseries.—Fruit nurseries, forest nurseries and nurseries of shrubs will furnish a surprising amount of instruction and pleasure for the pupils. Plan to start such features in the school garden, even if only on a very small scale. A few grafted apple trees, or budded peaches, or shade trees started from seed, or some well-known shrubs started from cuttings will reveal a world of interest.

Room for Experiments.—Plan to leave a little room in the garden for at least a few experiments such as those outlined in Chapter X and others in this book.

The Completed Chart.—After the plans for the planting have been determined upon, and the chart has been made, let a permanent copy of it be tacked to the wall or to a board to hang on the wall. Some schools frame the chart as a permanent record.

Copies of the chart may be used in the garden at planting time.

Plan of Garden, 180 Feet Long and 100 to 125 Feet Wide

Fence lined all around with Blackberries, Raspberries, Currants and Gooseberries.

1. Strawberries—early and late varieties.
2. Rhubarb or Asparagus.
3. Parsnips—Salsify—Carrots—Beets.
4. Onions for winter storage.
5. Early Potatoes—followed by Beans, Squash and Winter Squash, and Okra.
6. Early Peas, two or three plantings—followed by late Potatoes.
7. Lettuce—Radish—Early Spinach—followed by Sweet Potatoes.
8. Early Cabbage—followed by Sweet Corn with Pole Beans.
9. Early Green Onions from sets—followed by Bush Beans.
10. Early Sweet Corn—followed by Turnip Greens and Rutabagas.
11. Tomatoes—followed by Fall Greens.
12. Peppers—Egg Plant—followed by Winter Onions.
13. Bush Limas—followed by Celery Plants or Late Cabbage.

Measuring and Staking.—When the chart is ready the ground should be carefully measured off and staked before the planting begins.

This is good practice for the pupils. If the arithmetic period is used for this measuring and staking the time will be well spent. Future arithmetic problems may be based upon this exercise.

The garden will look better if the stakes used for marking the rows or beds or varieties are of uniform size and color. These should be made in advance by the pupils. For this purpose, some of the materials used by different schools have been each cut to sixteen inches or two feet in length, smoothed if needed, sharpened at one end, and given one coat of white paint. (1) Lattice strips, made for porch screens; (2) common plastering lath; (3) fence palings; (4) round tree branches, one inch in diameter and flattened on one side near the top; (5) special strips made for the purpose, about one inch square at the top.

Special gardener's labels are sold by seed companies to use for this purpose, and suitable sizes may be selected from catalogues.

Avoid using labels that are very small, as they are too easily covered up and lost.

As soon as the rows are staked, beds are assigned to individual pupils; the name of the pupil should be plainly *printed* on the side of the stake which faces away from the plants. On the side toward the plants will, perhaps later, be placed the kind of plants or seed, variety, date planted, and perhaps number of feet or fraction of row occupied. In placing the name and label on the stakes a very soft black lead pencil is simplest and best; th black lead lasts well on painted wood. Never use ink nor so-called indelible pencil, as they become washed off in the rain (see problems Chapter XXII).

Formal Gardens.—In private and public gardens of the Old World are frequently found beds of plants in perfect geometrical forms, instead of natural grouping. Such symmetry of outline and location of plants is less commonly found in American gardens. However, it is sometimes desired for flower beds in front lawns. In school garden work the so-called natural method of planting is usually preferred. Too much attention to fanciful forms such as stars, anchors, crosses, crescents, bells or wheels is not profitable for the pupils. The geometry or measurement of it is good practice; but pupils should not be trained to believe that such forms are essential, or even very desirable, for garden beds of any kind. To be sure, all flower beds surrounded by green grass must have some form, but a simple circle, oval or rectangle causes the observer to give his attention to the flowers rather than to the form of the bed. A good plan is to have the flowers in long beds or borders.

Window Gardens.—Some good, substantial boxes may be made by the pupils to hang under the windows or set on the window sills. They should be painted both inside and outside to preserve the wood and add to their appearance. These same boxes may be kept inside the windows in cold weather and outside when danger of frost is over.

Plans should be made to have suitable plants for the several purposes desired at the different seasons of the school year. These window boxes may furnish material to illustrate many lessons in nature study, such as leaf study, and relation of plants to light, seed germination, bulb growth, use of tendrils and other climbing devices. Many experiments may be carried on in the window boxes. The growth here will furnish the best of material for drawing exercises. A good

FIG. 19.—In cities, where children live in apartments, the roof is often utilized for gardening. (U. S. D. A.)

field for observation is constantly before the eyes of the children.

Roof Gardens.—Necessity sometimes demands the use of roof gardens when other places are not available. Figure 19 shows children at garden work on a roof. Flat boxes or trays are used to hold the soil. These may be taken to the school room for the special lessons suggested in the preceding paragraph.

Principles of Planning.—1. Plan early—any time during the fall, winter or early spring.

2. Do not delay the planning until the date is too late to show some results while school is still in session.

3. Start with a simple vegetable garden at first, and introduce the other things into the garden later.

4. Do not feel that all the conditions must be ideal at first. Let the children help make them so.

5. Choose plants which will give quick returns, particularly for small children—but remember other plants are also instructive.

6. Plan to avoid as much of the irksome toil as possible.

7. Make the school garden as much like the home garden should be as you can.

8. The space allowed for each small child may be very small, say only a few feet of a single row, if your space is limited.

9. The space allowed for older pupils should be increased considerably.

10. Plan for plant growth during the whole of the school year—fall gardens, winter gardens, early spring and late spring gardens. Window boxes and hotbeds will help much in winter.

11. In working up the plans for the school garden, constantly remember what will be wanted for use in the home gardens to grow during vacation.

12. The general beautifying of the school grounds should be part of the school garden plans.

13. Let the plans be simple, not fanciful.

14. Have the charts plain and the instructions explicit.

15. If the label stakes are all written and set before planting begins, it will simplify the work on planting days.

CHAPTER IV

GARDEN TOOLS AND IMPLEMENTS

THE first equipment for a school garden should not be too elaborate. As a general thing it should be very simple. The individual hand tools may be of very few kinds indeed. Many a teacher has successfully carried on school garden work with no other hand tool for each pupil than a garden rake. A few other tools used by pupils in common, from time to time, are always to be desired.

Rake and Hoe.—The most common and really most essential hand tools are the rake and hoe (Fig. 20). A large enough number of these should be supplied to assign one to each pupil, or, if pupils work in divisions, then enough to supply the members of a division.

The rake is very useful. It should be used even more than it is. Nothing is better, as a hand tool, in breaking up clods and in making a fine seed bed. After the soil is pressed firmly on the newly planted seeds, a "dust mulch" or loose layer of fine soil is produced by using the rake lightly. At all times between the rows of growing plants, a fine soil mulch is maintained by using the rake frequently. This kills many weeds that have germinated from their seed coats but have not yet sprouted above ground. No simpler and handier cultivator has yet been devised. Another form of hand cultivator is shown in figure 21.

The frequent use of the rake is better than hoeing. The hoe has fewer uses. The hoe and rake may both be useful at planting time. The hoe is also used to break up the soil and make it mellow whenever it becomes baked or very hard—particularly near the plants. It is useful in the thinning of such crops as beets. If weeds get too well started, particularly near the plants, the hoe is better than the rake in killing them.

The quality of these hand tools should be very good. Those made from good steel are always to be desired. The handles should be rigid, not flimsy. The sizes of hoes and rakes should be suited to the ages of the pupils. Four-inch hoes and ten-inch rakes are large enough for pupils ten years old or younger. Six-inch hoes and twelve-inch rakes are

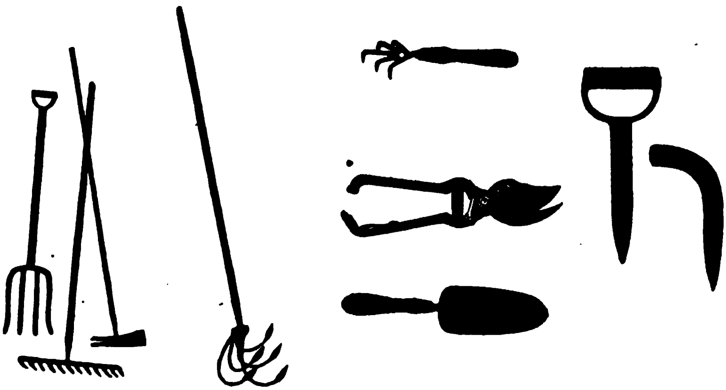


Fig. 20. Fig. 21. Fig. 22.

Fig. 20.—The spading-fork, rake, and hoe constitute the simplest garden outfit.
Fig. 21.—An inexpensive hand cultivator.
Fig. 22.—Hand weeder, pruning shears, trowel, and two forms of dibbers.

suitable for pupils of ten to twelve years or older—but the older pupils may also make use of tools, each two inches larger.

Other Useful Tools.—There are many other tools and articles which may be found useful in the garden—at school and at home. To mention some of them and their uses may be suggestive, particularly to the beginner.

A spading fork (Fig. 20), sometimes known as a potato fork, is useful in "spading up" or turning over the top soil to prepare it for planting. This is for small areas only, where a horse and plow cannot well be used. It is used also in digging the potato crop and in "lifting" other root crops, such as beets, carrots, and parsnips.

The spade is used for the same purposes and also in transplanting trees and shrubs.

Shovels are most useful where much dirt is to be handled, as in digging drains, levelling and terracing yards, and making irrigation ditches.

A pick may be needed to loosen hard or stony soil before it can be shovelled.

Grubbing mattocks are used in place of picks and also in removing roots of trees and shrubs when "clearing" new land. They are sometimes used to loosen up small plots in lieu of plowing or spading up the soil.

Dibbers and garden trowels (Fig. 22) are almost necessary in the transplanting of such vegetables as cabbages, tomatoes, egg-plants and peppers.

Small weeders (Fig. 22) to be used in one hand are helpful when the plants are very small or very close together. The soil is readily loosened and made into a fine mulch in small garden beds by use of hand weeders.

Hand weeders may be made by using old broom sticks. The length should be about 8 or 10 inches. The upper end should be rounded and made smooth for the hand. The lower end may be chisel-shaped or pointed, as desired. For planting purposes the chisel-shape may be useful, but for loosening the soil, for thinning and for weeding the pointed end may be preferred.

Marking boards are useful in planting seed boxes and small beds. A marker for the open garden is shown in figure 23.

Sieves are necessary in preparing soil for use in boxes, plant trays, and flower pots. If the manure used be trashy or the soil lumpy, even a coarse sieve will help make the mixture much better for these purposes.

A sprinkling can, or some other means of watering, is nomic point of view they are not necessary in small gardens; but if the school can secure them, it is well to teach their uses to the pupils. They will be found very useful in the larger home gardens and in market gardens.

A one-horse cultivator (Fig. 25) may also be owned by the school if considerable cultivation is to be done by horse power. Renting a cultivator for the purpose is usually possible, but often the shovels are too large and not suitable for the best garden work. Select a cultivator with many small shovels or harrow teeth.

The plow to be used in preparing soil for school garden work may be either borrowed, rented or purchased. It should

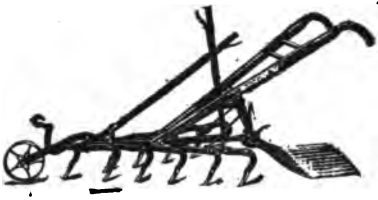


FIG. 25.—This form of one-horse cultivator is well suited for garden work. It can be adjusted in width to suit all rows.

have a mould-board of medium length and curvature, neither too long nor too short and steep.

The harrow should be chosen to suit the type of soil. Light soils may be made fine with a common spike-tooth harrow or "drag"; but an Acme pulverizer is a good general purpose harrow and is one of the best for soils that are heavy enough to form hard clods. Always use the harrow on the garden the same day it is plowed.

Pruning shears and pruning saws are not expensive and may be owned by such schools as have an opportunity to teach their uses. Another plan is for each pupil who has home uses for them to buy the shears (Fig. 22) and saws and let them be used both at home and at school.

Grass hooks and lawn mowers may be owned in either of these ways.

Fencing for the school garden is usually necessary, for obvious reasons. Some good form of woven wire has been found to be most popular. It is neat and pleasing and may be selected of suitable height and mesh to keep out all farm animals. It is much cheaper and more durable than fence boards. *Posts* should be set about two feet into the ground and high enough to extend about four inches above the woven wire. A single line of barbed wire is then stapled at a uniform height above the top of the woven wire and on the opposite side of the posts. This makes the fence harder to climb over. The posts may be of cedar, chestnut, oak, or other durable wood. These should be peeled or stripped of their bark and then painted with coal (gas) tar all over before being set in place. This makes them last fully twice as long. The posts may be sawed to a uniform height after the wire is on, and the top six inches painted with white, red or green to help offset the black color of the tar paint.

Hotbeds and coldframes are described in Chapter V.

TOOL HOUSE

A place to keep the garden tools should be provided in some way. In small schools this is usually a locker or cupboard of suitable size; in some cases, a tool box is made long enough for rakes and hoes. The cover is slanting to shed off rain, and a lock is provided.

In larger schools a small house is used for tools, seeds, fertilizers and other supplies. In such a house or room there should be an assigned place for everything. A card is placed to indicate the location of each kind of tool.

This room may have in it any or all of the tools and articles of equipment already mentioned, and also some of the following things, if the work of the school requires them:

Bins of soils, sand, and fertilizers for potting of plants, seed germination and experimental work.

Black-board to use in directing the daily operations of the class.

Grindstone, whetstones and files for sharpening tools.

Seed jars or boxes, to be proof against mice. Also seed bottles to be used in planting.

A bench or box of soil for the temporary storage of live plants, cuttings, scions and grafts.

A clock.

A wall thermometer, and perhaps several soil thermometers.

Pigeonholes for labels, twine and the smaller tools.

Box lumber and saws, hammers and nails for making plant trays, window boxes and other articles.

In such a garden house are sometimes placed on the wall a few cases containing the common forms of injurious garden insects. Pressed specimens of some of the plant diseases may be mounted under glass and hung on the wall. Here the pupils can compare specimens from the garden and quickly identify them. Here may be kept insect nets, collecting bottles and insecticides.

A small box of emergency supplies to use in cases of accident, bandage cloth, absorbent cotton, adhesive plaster, antiseptics, soap, ammonia, and vaseline or ointment.

Buckets, basins, mirror, soap and towels for use after the garden work.

Floor brooms, whisk brooms, and shoe brushes.

CHAPTER V

HOTBEDS AND COLDFRAMES

Hotbeds and coldframes are both very useful in school gardening as well as in home gardening (Fig. 26).

By the use of these some gardening can be kept up all the winter season. No one need then object to school garden work on the plea that many schools are not in session during the best garden season. When there are hotbeds and coldframes, winter is one of the best garden seasons.

Fig. 26.—A hotbed of suitable size for a home garden, 6 by 6 feet. These sashes are of lap glass.

Uses.—With the opening of the fall term of school, pupils start a number of suitable kinds of plants in the coldframes. Here they are protected from cold nights and from frosts during the fall months and from the cold days of early winter.

These coldframe crops, or nearly all of them, may be grown and harvested by January (Fig. 27). A little later the coldframes may be transformed into hotbeds, as described farther on in this chapter.

In the middle of winter or very early spring the hotbeds should be prepared, and seeds, cuttings, bulbs, and plants of many kinds started. These may be such things as will mature during the cold weather in the hotbeds, or they may be intended for transplanting to the open garden in spring.

Plants for the Coldframes.—Seeds of lettuce, radish, pars-

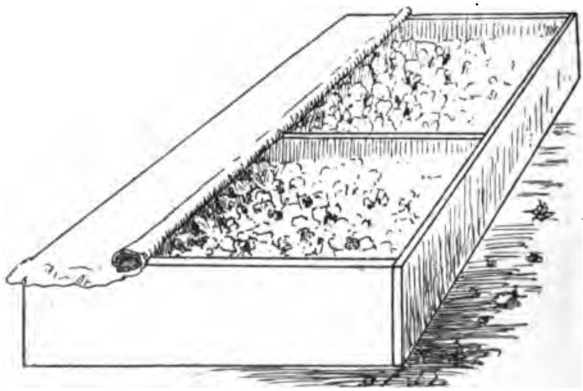


FIG. 27.—A coldframe with a cloth cover will furnish protection from frost for lettuce and other semi-hardy plants in spring or autumn.

FIG. 28.—Transplanting in a coldframe. (Rittenhouse School Gardens.)

ley, spinach, turnips, early garden beets, kale, and carrots, and sets of winter onions are all suitable vegetables to start in the coldframes in the fall (Fig. 28). The glass over the frames will protect from cold fall winds and will help gather the sun's heat for the soil and plants.

There are many plants growing in the garden in summer which would continue to thrive if taken into the coldframes in

FIG. 29.—Head lettuce on left, leaf lettuce on right—grown in coldframe and ready for cutting at Thanksgiving time. (Kentucky Station.)

the fall (Fig. 29). Celery may be thus transplanted when cold weather sets in. It should be well covered or shaded and the blanching process may be completed.

Numerous flowers may continue in their growing or flowering condition by transplanting large clumps with plenty of roots and soil into the coldframes. Pansies, sweet violets, verbenas, ageratum, everlastings of several kinds, geraniums, low asters, chrysanthemums, nasturtiums, and many others, if moved carefully, will pay well for the trouble and will help to form a winter flower garden. Potted plants and window boxes may be protected several weeks in coldframes built at the school.

A number of perennial flowers may be started from seeds planted in coldframes in August, to flower out-of-doors the next season. Try violets, pansies, larkspur, phlox, foxglove, and many others.

FIG. 30.—Sweet-potato plants may be grown from the potatoes in hotbeds in early spring. The plants may be either used or sold. (New Jersey Station.)

Bulbs of such flowers as hyacinth, daffodil, tulip, narcissus, crocus, and others do well if started in coldframes and then placed in hotbeds or warm rooms later in the winter.

It is well to pot the bulbs either in earthen pots, tin cans, or berry boxes, and keep them cool and well watered for a few weeks before forcing them too much.

Plants for Hotbeds.—Seeds of quickly growing vegetables are very suitable for hotbeds in late winter and early spring.

Radishes, carrots, early table beets, lettuce, spinach, early peas, and others may be matured in the hotbeds. These beds may be used to start such plants as tomatoes, cabbages, cauliflower, celery, head lettuce, peppers, egg-plants, sweet potatoes (Fig. 30), parsley, cucumbers, muskmelons, and perhaps others which are easily transplanted to the open garden later in the season. The plants so started will gain enough growth in the hotbeds to make them much earlier for use. In some cases it will cause them to mature before vacation time. Others, as tomatoes, celery, and melons, may thus be well established in the school or home garden before the vacation.

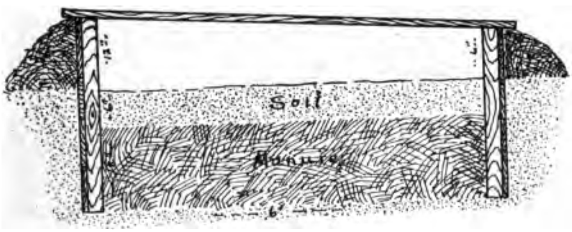
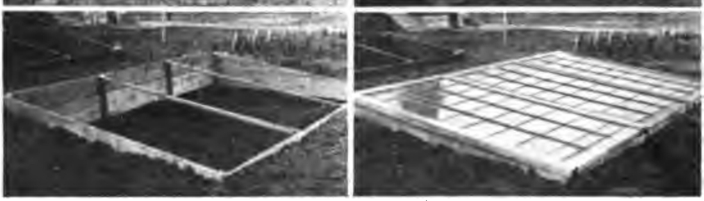


FIG. 31.—Cross-section showing construction of hotbed. The glass sash on top slopes toward the south to catch the rays of sun.

There are many annual flowering and foliage plants that ought to be planted first in the hotbeds to give them an earlier start. When the weather is suitable they may be transplanted to the school garden or to home gardens. A few of the favorite annuals are: aster, ageratum, alyssum, castor bean, chrysanthemum, cockscomb, coleus, cosmos, mignonette, nasturtium, petunia, primrose, scarlet sage, and zinia. There are also a few perennials, as pansies, which will blossom much better the first season if started early in hotbeds. Such bulbs as caladium, canna, dahlia, and those hardier kinds, crocus, daffodil, hyacinth, narcissus and tulip, may be started ahead of season in hotbeds with much advantage. They would be ready for transplanting as the season advances.

How to Make a Hotbed.—Boys, or any others who have learned to handle tools, cān make a hotbed or a coldframe. Study figures 31, 32, 33, and 34. First make a tight frame of

A *B*



A *B*

FIG. 32.—First two steps in making a temporary hotbed. *A*, three-sash pit, one foot deep. *B*, Manure ready for the pit. (Kentucky Station.)

FIG. 33.—Two more steps in the preparation of a temporary hotbed. *A*, the manure is spread in the pit and tramped firmly. *B*, three-sash frame showing details of construction. (Kentucky Station.)

FIG. 34.—Two last steps in preparing a temporary hotbed of three sash. *A*, frame in place over manure, which has been covered with soil, and sides of frame banked to protect from cold. *B*, the three-sash bed completed and covered. (Kentucky Station.)

boards of a size to suit the glass sash, say 3 × 6 feet, three sash may be used, making the frame 6 × 9 feet, as in figure 33B. The frame should be about two feet deep on the north side and six inches less on the south side. This gives a little slope to the window sash to catch the rays of the sun. Place the frames in a location protected from north wind, clearly exposed to the sun.

1. **Making a Hotbed.**—A hotbed can be made with little cost. Let the students do all the work. They will be glad to. They work with more earnestness and zest than they do at some dry inside work. One or two discussions as to how to build a hotbed should be taken up in the class room and some definite plan adopted. Hints can be found in bulletins and farm journals. (See Cornell bulletin on "Hotbed Construction and Management.") Plants can be grown at school and then taken home to be placed in the front yard or home garden. Plants grown in a hotbed may be sold to defray the expense of material for making the frames.

Seedsmen or students' parents will be glad to furnish seed with the understanding that they may get a few dozen plants for use later.

Special hotbed sash are made with either single glass or double glass. But sash made for ordinary windows may be fastened together in pairs. Place the two parts end to end and then nail a light strip of wood on each side to hold them firmly together. These strips should be as thick as the sash and about one inch wide. Such pairs of window sash may be placed side by side in any numbers desired. Thus the beds will be six feet from north to south side, if six feet is the length of the pair of sash. The length of the bed from east to west may be made to suit any number of sash desired. The persons in charge of the hotbed can work from both north and south sides.

About twelve inches of fresh horse manure is tramped into a pit of that depth and then the frames are placed over it (Fig. 33). Six inches of good garden soil is placed in the bottom of the frames on top of the manure. The manure and soil will be warmed by the sun when the glass is in place; or the manure may be started to heating by the addition of warm water.

Dirt should be banked up outside the frames to prevent the escape of heat during cold weather (Fig. 34).

How Hotbeds are Warmed.—There are two sources of heat for the hotbed: (1) The rotting manure in the bottom of the bed causes a great deal of heat which warms the soil, plants, and air of the bed. (2) The bright rays of the sunshine through the clear glass without warming the glass; but these bright rays striking the soil and plants inside the bed are changed to "dark" or obscure rays; these dark rays will not again go through glass readily. Thus the rays of the sun enter the bed, are trapped by being changed in character, and do not readily escape.

By these two methods of heating, a bed may become warmed too much even on cool days. It is partly for this reason that covers or shades are used and that ventilation is used.

Coldframes and Hotbeds Compared.—Coldframes may be of the same construction as hotbeds, with the exception of the fresh manure. No heat from the bottom is used in a coldframe. The glass of the coldframe is kept covered in cold weather with matting, carpeting or other material to keep out the wind. Of course, with hotbeds, such protection is also used on cold nights and cold, cloudy days, but the glass is uncovered on bright days to admit the rays of the sun through the glass.

Operating a Hotbed.—There are a number of special things to attend to while running a hotbed.

The temperature must not become too hot nor too cold at any time. Some variation in temperature between night and day must be expected. A thermometer should be kept in the hotbed so that the operator will not need to guess as to the temperature. Some plants, as radish, lettuce, beets and carrots, are best suited by cool conditions and others need to have the soil and air warmer, as tomatoes, egg-plants and peppers. So no rule can be established as to an exact temperature for all plants. Those plants which are mentioned as being hardy enough to endure late spring frosts are the plants which thrive better when the day heat in the bed does not exceed 60° or 70° Fahr. The summer or "hot weather" plants may be forced early in a hotbed, but they prefer a day heat ranging from 70° to 85° Fahr. The same differences are to be observed for the lower temperatures, which usually come at night. That is, the "cool weather" plants endure a night temperature of 40° or so; while the "hot weather" plants should not be allowed to drop below 45° or 50° at night or on cold days.

The ventilation of the hotbed must be watched closely. It is by the raising of one end of the sash that a little air is allowed to circulate in the bed. The ventilation is carried on abundantly on warm days and is much less on cooler days. Avoid cool winds on the plants just after they have been shut up in a hot moist bed.

The moisture is not so difficult to regulate in a hotbed as in the open garden; but during warm days when the glass is raised for ventilation moisture will escape very rapidly. The soil is easily kept in proper condition by applying water in small quantities frequently, say early every sunny morning.

CHAPTER VI

PLANTS IN RELATION TO SOIL, LIGHT AND AIR

THE intimate relations existing between plants and their surrounding elements may be clearly shown by means of such simple exercises as those suggested in this chapter.

1. Absorbing Moisture.—Arrange two pots or cans inside two small lard pails as shown in figure 35. The two flower pots are filled alike with the same kind of good garden soil. A few kernels of corn are planted in one of them. After the corn is a few inches

FIG. 35.

FIG. 36.

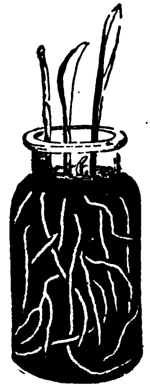


FIG. 35.—Two pots of soil are immersed in the same amount of water in the outer vessels. Corn is grown in one pot but none in the other to see the difference in evaporation. (U. S. D. A.)

FIG. 36.—Plants grown in glass bottles wrapped in dark paper to exclude the light. When the wrapping is removed the root system is exposed to view.

high, have the water in the lard pails filled to the line shown in the figure. Keep it filled daily up to the mark, and note the amount required for each pail in a week. The one with the growing plants will require the most, because of the water taken up by the growing plants.

The growth of plants cannot take place without the use of water taken up through their roots. This water comes from the soil. When the growth is rapid, much water is used. The growth of any plant is governed by the amount of water which it can secure through its root system. Oats require 504 tons of water to produce one ton of dry matter when harvested; corn 271 tons; peas 477 tons; potatoes 385 tons. These facts show the importance of having plenty of moisture in the soil during the growth of the crops.

2. Root Hairs on Young Plants.—Plant a few seeds of radish, beans or kernels of corn in moist sand in a glass jar or bottle with

FIG. 37.—Germinating oats and barley showing the young roots with numerous root-hairs. (Productive Farm Crops.)

wide mouth. Wrap some dark or black paper around the bottle to keep out the light (Fig. 36). Place in a warm room and water a little every day for a week or so. As the seeds start, the roots seek darkness and the leaves seek light. Remove the paper and observe the roots on the inside surface of the glass. By looking close, the plush-like root hairs will be seen on the young roots.

Root hairs are formed on the fibrous roots of plants. They are of a velvety nature. They are useful to the plants in absorbing moisture from soils.

If the bottle is examined several times during germination, the roots will be found to grow much more rapidly than the tops of the corn plants. This explains why corn is not so easily destroyed as some weeds by a cultivator or other garden implements.

3. **Root Hairs Form Early.**—Between the folds of wet cloth or blotting paper, germinate seeds of peas, oats, beans, and squash. They may be placed inside a glass jar to prevent evaporation. After a few days, examine them and look for the abundant growth of root

FIG. 38.

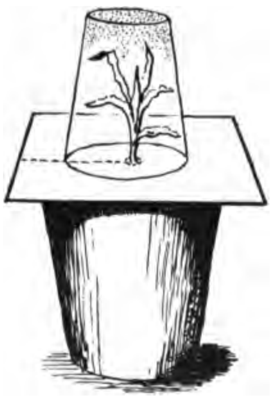


FIG. 39.

FIG. 38.—A potted plant with glass inverted over it will show moisture given off by the leaves.

FIG. 39.—The lower membrane of the egg is exposed to water in the bottle. The two liquids tend to exchange places through the membrane, but the water moves faster and soon fills the egg to overflowing. It then rises in the glass tube above.

hairs on the roots. Note that at the very tip of each root there are no root hairs (Fig. 37).

The early formation of the velvety root hairs shows the effort of the young plant to obtain moisture from soil as soon as germination takes place.

4. **Leaves Expel Moisture.**—Invert a drinking glass or fruit jar over a growing plant. A card should be placed over the soil under the glass, excluding the soil moisture from the glass (Fig. 38). If the plant is placed in the warm sunshine, only a few hours will be required to show moisture collecting in the glass. This comes from the leaves of the growing plant.

All plants give off moisture from their leaves. The rate of evaporation depends upon the temperature, amount of wind, and the amount of moisture which the plant can secure through its roots. Growth is measured by the amount of water used or given off through the leaves. Plant-food comes along with moisture taken up by the roots. If evaporation is checked by cold weather there will be less plant-food used and the growth is checked.

5. Osmosis.—Place a few slices of dried apples in water. In an hour or so, they become more rigid because of the water taken into the cells. At the same time, place a few slices in strong salt water. Note the difference in time required to swell the slices in brine. Perhaps they will not swell at all in the brine.

The process by which the moisture enters the cells of the fruit or enters the roots of plants is called osmosis. Much of the liquid outside the cells enters the roots, and a little of the sap in the roots passes into the soil at the same time. Osmosis is the trading of two liquids through the membrane surface. The liquid of the plant is denser than water; but the sap may not be denser than strong brine. In the trade of the two liquids in any case, a very little of the denser liquid is exchanged for a large quantity of the thinner liquid.

The exercise may be varied by using a few slices of wilted apple or wilted potato, if dried fruit is not readily available. (See also the experiment shown in Fig. 39.)

When soil water is made too dense by strong applications of fertilizer too near the plant, it will cause the wilting of the plants. It defeats the purpose desired by the gardener. Fertilizer should be mixed thoroughly with the soil a little ways from the seeds and plants, not too near them.

6. Overfeeding of Plants.—Take two plants of the same kind from the soil of a window box or garden. Two large lettuce plants would do. Place one in a tumbler of water and the other in a strong solution of sugar syrup. After a few hours, the first is observed to remain fresh and the second has wilted.

The movement of liquid in one case is opposite in direction from the other. In the first case, the water moves into the plant and keeps it fresh because the cell sap is denser than the water. In the second case the cell sap is weaker than the sugar syrup and the movement of liquid is toward the syrup. This causes the wilting of the cells of the plant.

When plants are in soil where the soil water is denser than the cell sap, they will wilt instead of grow. This may be the case when too much fertilizer is placed close to very young plants.

7. Sunlight Needed for Growth.—In a window box of plants, place a tin can over a few plants in such a way as to entirely exclude the light from them. After a few days, notice that the green color of the leaves is mostly gone. In time, the plants will be killed.

Gardeners place celery in trenches, dark cellars, or similar places, to exclude the light. This causes the color to leave the stems and makes the product much more salable.

Plants require light on their leaves for their best growth. If a box is inverted over green grass on a lawn for some time it will kill the grass. If weeds in the garden are thoroughly covered with soil by the use of a cultivator, they will probably be killed. Mulches of straw about strawberries or other garden plants help to prevent the growth of weeds.

8. Leaves and Light.—In the window box of growing plants, observe the leaves with their broad surfaces turned toward the light. If possible, turn the box around and note the time required for the leaves to change their position and turn again toward the light.

Leaves of plants growing in a crowded condition, as in a closely planted garden or in a forest of trees, seek the light. The lower branches of an elm tree, for example, bend down, the middle branches are more nearly straight out, and the upper branches extend upward. This arrangement of the leaves and branches of the tree gives the tree the greatest amount of light exposure. Note the effect of light on sprouting tubers as shown in figure 40.

9. **Plants Use Carbon Dioxide.**—Light a short piece of candle and fasten it with some of its own melted wax to a flat piece of cork or light wood so it will float upright on water. Tie to the candle a string two feet long. Set it in a pan of water and invert an open fruit jar just above it with the edges of the jar in the water. The candle will burn only a short time, and the flame goes out for lack of oxygen. The oxygen has been partly converted into carbon dioxide by the burning of the carbon in the candle. Now remove the candle by pulling it through the water by means of the string, allowing no

FIG. 40.—Potato tubers sprouted in light (left) and in the dark (right). The left one is plump, green, and the sprouts are more abundant. The right one is shrunken, and the sprouts are fewer and longer. The tubers may well be exposed to light for many days just before planting. (Productive Farm Crops.)

fresh air to enter the jar. Introduce a leaf or two of geranium or other window plant. A cork float may be used in keeping the leaf surface above water. The stems should remain in the water to keep them fresh. Now place the dish where the bright sun may strike the leaves through the jar. After two days remove the leaf and test the air by burning a candle in it. The burning, even for a short time, will prove that the action of the leaf in the sunlight broke up some carbon dioxide and left oxygen in its place.

When plants are growing in daylight they use up the carbon dioxide of the air and leave the oxygen. This in turn is used by animals in breathing; it also helps to produce combustion wherever fires are started.

During darkness plants do not break up carbon dioxide, but actually produce it, using some oxygen as animals do.

10. **Balance Between Plants and Animals.**—In a large can or glass jar, make an aquarium as shown in figure 41. Several kinds of water plants secured from ponds or lakes are planted in clear sand in the bottom of the jar. Pollywogs, water snails, small fish, and water insects, such as dragon-fly larvæ, may be placed in the jar. When all is ready, allow the aquarium to stand for several days in a very light place. As the plants begin to grow they will give

Fig. 41.—A sunlight aquarium. The plants furnish oxygen and the animals use it. The animals produce carbon dioxide and the plants use it.

off oxygen to the water. This in turn is breathed by the small animals present. If the aquarium is nicely balanced in the two main forms of life, the supply of carbon dioxide given off by the animals will cause the plants to thrive, and the oxygen supplied by the plants to the animals will satisfy their breathing requirements. If any of the fish come to the surface to breathe there are probably too many animals present. The inside of the aquarium may be kept clean by rubbing with a stick wrapped with cloth. Snails and pollywogs are scavengers and will eat much of the waste matter inside the glass and on the plants. Too much food should not be supplied the animals, as this pollutes the water.

The exercise does not prove conclusively that plants decompose carbon dioxide. The preceding exercise shows that better, but the fact is the only one which explains well the conditions found in a well-balanced aquarium.

11. **Types of Roots.**—Study the roots of several different plants from gardens, fields or waste places. The fleshy roots of beets or parsnips may be compared with the long tap-root of clover or alfalfa. Compare these with finely divided fibrous roots of such plants as yarrow, timothy or raspberry. Compare the roots of annual weeds with perennial weeds. Fleabane and ragweed are examples of annuals which have a rather straight tap-root with a number of side roots. The tap-root is hard but not fleshy. Toad flax, oxeye daisy, and dandelion are examples of perennials. Roots of perennials are never as simple as those of annuals. Provision is made for the storage of plant-food in fleshy roots or underground stems. Often buds are formed underground for the growth of plants in following years. See if these can be found.

If the young gardener will learn by careful observation to note the differences between roots of annuals and perennials, it will aid him in combating weeds of various kinds and in the care of perennial garden plants during the dormant season. Perennial borders must be cared for in fall and early spring, and the gardener should know the different forms of root systems to avoid destroying the valuable plants.

CHAPTER VII

HOME AND SCHOOL EXERCISES

A NUMBER of lessons with soils and plants are best taught by means of exercises. Those concerning plants most closely related to garden work are outlined in this chapter (Fig. 42).

With many of the pupils, the experiments carried on in school and in the garden will stimulate interest in the other garden work. This is true of those who might otherwise think some of the garden work a little irksome.

The few experiments outlined here will suit schools that

FIG. 42.—Many tests with fertilizers may be made in glasses, tin cans, and flower pots. Here the trial is with different forms of lime in 1, 2, 3, and 4; compared with magnesia in 5. (Agriculture and Life.)

do not have special funds for expensive equipment. The simple materials or apparatus used may be brought by pupils from their homes and returned, if desired, afterward.

Some of the experiments may be tried at home when conditions at the school seem less favorable. For those which require a rather uniform temperature, the homes of pupils may be somewhat better than the school room during cold weather.

STUDIES OF SEEDS AND GERMINATION

1. **Garden Seed Selection.**—In the fall of the year, students may select garden seeds of many kinds. In doing so, attention should be given to several visible characters, so that seeds may be chosen

from the best. If there be no seeds in the school garden, the work may be carried on by individual pupils at home, and the results shown at school. The size and vigor of plants, the quantity of seeds

FIG. 43 AND FIG. 44.

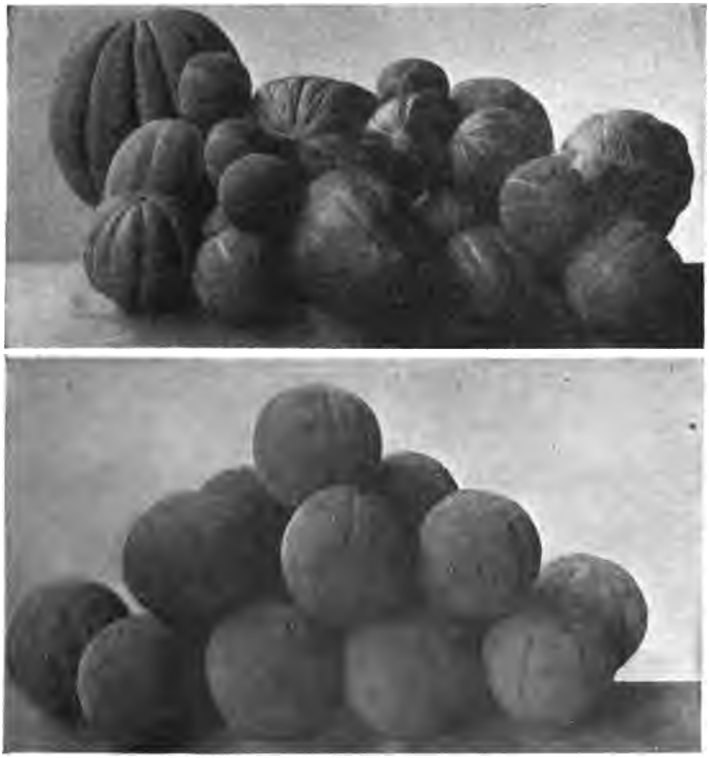


FIG. 43.—Melons grown from unselected seed—showing the mixed product. (North Carolina Department of Agriculture.)

FIG. 44.—When seed is selected from a garden where the product is uniform the next crop will be uniform. (North Carolina Department of Agriculture.)

they bear, the strength and height of stems, the branching or number of stems in a clump, are all features to be considered (Figs. 43, 44, and 45). Tomato seeds should be taken from plants yielding large crops of smooth marketable fruits. The individual tomatoes should have small seed cavities and abundant flesh (study figure 46). Select seeds of asparagus, rhubarb, peppers, egg-plant, radish, lettuce, and such two-year plants as beets, cabbage, cauliflower, salsify, and parsnip.

Fig. 45.—Hubbard squash cut open, showing small seed cavity, and a thick edible portion. (Cornell Reading Course Leaflet.)

Many gardeners do not choose seeds from their own gardens, but purchase them in packages from dealers. Young gardeners should learn the advantages gained by selecting

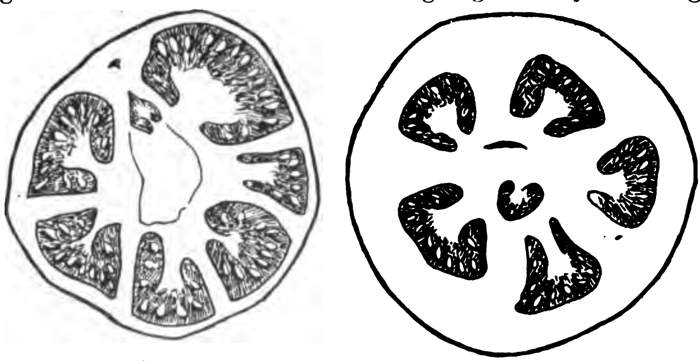


Fig. 46.—Tomatoes vary in the amount of seed pulp as compared with the flesh. Compare the left with the right. Which kind would you save seeds from?

home-grown seeds. Plants from such seeds do better in soils where they were grown. Individual attention given to the important features necessary for improvement counts for much in plant breeding.

2. How Plants Get Out of the Ground.—Start a number of large seeds of different kinds, such as beans, peas, corn and squash. They may be planted very shallow in a box of wet sand. As they start germination, remove the sand from a few of each kind and study their plans of growth. Continue this study as the growth continues. Which seeds are pushed entirely out of the ground before the seed leaves burst from the coats? Which ones leave the main part of the seed in the ground? What do these send up? Compare carefully the difference between peas and beans; between corn and squash.

During the exercise, much difference will be noticed in the strength of sprouting shown by different kinds of seeds. Gardeners often plant strong sprouting seeds among weak ones to aid in breaking the soil for them. This is one reason for planting radish and lettuce seeds together. The roots of some plants are forced downward into the soil by penetrating the soil without pushing the seed leaves and seed coats upward. Such plants have less difficulty in sprouting from poorly prepared seed beds.

PLANT GROWTH AND POLLINATION

3. Moisture and Germination.—In a can of moist garden soil, plant fifteen kernels of corn or other large seed. In a second can, with the same kind of soil which is air dry, plant the same number of seeds in like manner. Keep both cans in a warm room and keep the moist one well watered. After a few days, sprouting will be seen from the moist soil, but probably none from the dry soil.

There are three essential conditions for germination: moisture, warmth, and air. This exercise proves the need of moisture.

4. Packing and Germination.—Fill two cans alike with the same kind of moist garden soil. In each plant the same number of kernels or seeds. Leave one soil very loose at the top and around the sides. Pack the other with the fingers or bottom of a bottle so the moist soil is pressed firmly against the seeds. Place both cans in a warm room, and after a few days carefully watch and note the difference in the time required for germination. Usually, packing hastens germination.

Moist soil packed closely against seeds planted in the garden causes them to sprout more rapidly. After planting fine garden seeds, the row should be packed by tramping upon it or in some other manner. Fine seed such as timothy or other grass seed, when sown in the field, is often rolled so that the moisture from below will rise and come in close contact with the seeds and soften their coats.

5. **Air and Germination.**—In two cans of garden soil, plant seeds alike. Have one moistened, favorable for the best germination, and the other supplied with enough water to stand over the top of the soil. Keep both cans in a warm room and observe the results. The seeds in the first can should sprout in a few days. Those which are over-watered will probably rot instead of sprouting.

This exercise may be varied by placing wet blotters or wet cloths with a few seeds in the bottom of a bottle or glass jar. In a similar vessel, put a like number of seeds and cover them with an inch or two of water. Those in the moist condition will have enough air to germinate, while those in the water will not.

Air is very essential to the proper germination of seeds and future growth of the plants. If too much water is present, the air is driven out and the seeds or plants will not grow well. The exercises demonstrate the importance of good drainage of soils.

6. **Warmth and Germination.**—Plant seeds in two cans of soil, similar in every way, but keep one of them in a warm room and the other in a colder room or perhaps out-of-doors. Note the difference in time required for germination. The temperature of each may be noted if a thermometer is available.

Certain kinds of seed require very warm soil before germinating. Others will not need it so warm. Soils may be warmed by suitable tillage for a few weeks before planting time. This will let in the warm spring air and make the soils warm enough for the germination of garden seeds.

7. **Depth and Germination.**—In a glass jar or in a box somewhat deeper, plant such seeds as corn, beans, and peas, at varying depths of one, two, three, four, and five inches. Two of each kind

of seed may be used at each depth. The soil should be packed uniformly and the moisture conditions kept as nearly perfect as possible. Place in a warm room and record the time required for the seeds at different depths to germinate. The location of those at each depth may be marked on the side of the box with pencil or on the side of the glass jar with paper labels. The exercise may be varied as shown in figure 47.

If the soil used is a sample from the garden, the exercise

FIG. 47.—An exercise to test the depth for planting corn or garden seeds of any kind. (Agriculture and Life.)

may be valuable in determining the best depth at which to plant seeds. If planted too deep, seeds may rot before reaching the surface. If planted too shallow, they may suffer more from drouth because their root systems are too near the dry surface.

8. Carbon Dioxide from Germinating Seed.—Put a half pint of germinating beans in a glass jar. Place among these a wide-mouthed bottle containing clear lime water and cover the glass jar. After a few hours, the lime water will show a cloudy or milky

appearance and a scum or crust will form on top. This indicates the presence of carbon dioxide, which is always given off by germinating seeds.

This shows one need of a good supply of fresh air during germination, as proved in another exercise in the early part of the chapter.

The student may prove that carbon dioxide produces these effects on lime water by bubbling from his mouth through a straw or tube into a glass containing fresh lime water. It is the same kind of gas given off by the germinating seeds as by the lungs.

9. Importance of Large Seed.—In two cans with perforated bottoms, place moist garden soil and plant in them radish seeds of the same kind. In one can, plant twenty of the largest seeds, and in the other twenty of the smallest seeds. Keep them in the best growing condition. Note any differences which may be seen. The test should be made by more than one student and comparisons may be made. Be careful to have the soil packed and watered alike, and the depth of planting should be the same in all cases. The growth may be continued for two or three weeks. At what stage of growth does the size of seed seem to make the most difference?

In preparing seeds for planting, sieves are used to select the large from the small. Fanning mills are used to separate the light seeds from the heavy. These methods help to improve the growth of future crops as well as to remove weed seeds from the field seeds desired. In ancient times farmers allowed the seeds to fall through the air while the wind was blowing. The winnowing of grain aided in the selection of seeds for future crops. Careful selection of the heaviest and largest seeds each year will greatly improve the vigor of the plants and increase the yield. Farmers and gardeners should always select the best grain or best garden seed for their own use.

10. Seed Testing, Soil Method.—Plant two lots of seed in a shallow box of moist sand or light garden soil. The seeds should be counted, each lot containing the same number, say twenty-five

for large seeds, or one hundred for small seeds. Place the box in a warm room and keep it well watered. Note the rate of germination, and after the strongest plants have been up several days, determine the per cent of germination.

The sprouting of seeds will help to detect impurities in the sample. Differences between seeds may not be observed, but the difference in their leaves or manner of growth is quickly seen.

Testing proves the vitality or germinating power of the seed sample. This should always be known before planting seeds in the garden or field. It may save the many disadvantages of buying and planting poor seeds. The vexation of replanting is avoided.

11. Seed Testing, in Wet Cloth.—In folds of wet cloth, place counted seeds with a label made with pencil on a small paper. The cloth is placed between plates or pans to hold the moisture. The cloth should be moistened frequently, and the samples kept in a warm room for a number of days. The per cent of germination should be determined by careful counting of dead seeds.

For the testing exercises, have grains and garden seeds brought to school by pupils. These may be such as are to grow in the home or school garden the following season. Pupils may do the counting, labelling and testing by each method described. This is best done before the early spring work begins. A record should be kept on the packages or bottles containing the seeds.

The samples may have been obtained from stores or seed houses wishing to sell them. It seldom pays to buy cheap seeds. A test will greatly aid in deciding what to buy. The age, size, weight, purity, and vitality should always be determined before buying. Old seeds are sometimes given a fresh-looking appearance by using fumes of sulfur. These are sometimes used to adulterate good seeds.

12. Looking for Weed Seeds.—Samples of lettuce or other small garden and field seeds should be examined for purity by each pupil before garden planting time. Spread half a teaspoonful of one

kind on a sheet of white paper. Weed seeds or any which are not like the true garden variety you have should be placed at one corner of the paper. Lift them with the wet point of a pencil. After separating the seeds which are untrue, count them and determine the percentage of purity (Fig. 48). Another way of looking at seeds is to moisten the first joint of the thumb of the left hand and dip it in the seed sample. The layer of seeds covering the moist surface may be examined with the eyes with or without a lens or reading glass.

Such practice by students calls attention not only to impurities, but also to shrivelled seeds, discolored or old seeds,

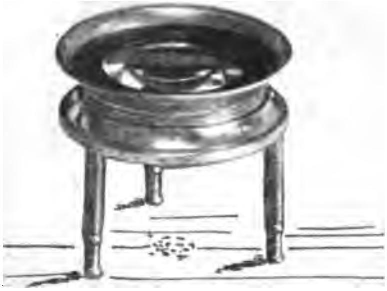


FIG. 48.—Garden seeds should be examined for weed seeds. A lens will aid with small ones.

particles of dirt, sand or other foreign matter often found in samples (Fig. 49).

13. **Studying Weed Seeds.**—During the fall season, collections of weed seeds of many kinds should be made at the school. Let each pupil bring to school the heads of weeds containing seeds. These may be placed in folded papers or discarded envelopes, with the name written outside. After the samples have become thoroughly dry, place the seeds in small bottles, as shown in figure 50, or in little boxes. Any weeds which are not known by the pupils or teacher may be identified by the use of United States Farmers' Bulletins No. 260 and No. 382. Samples may also be sent to the agricultural experiment station in any state.

The exercise will call the attention of pupils for the first time to many noxious weeds, and they may realize for the first time the importance of the farmer's weed problem.

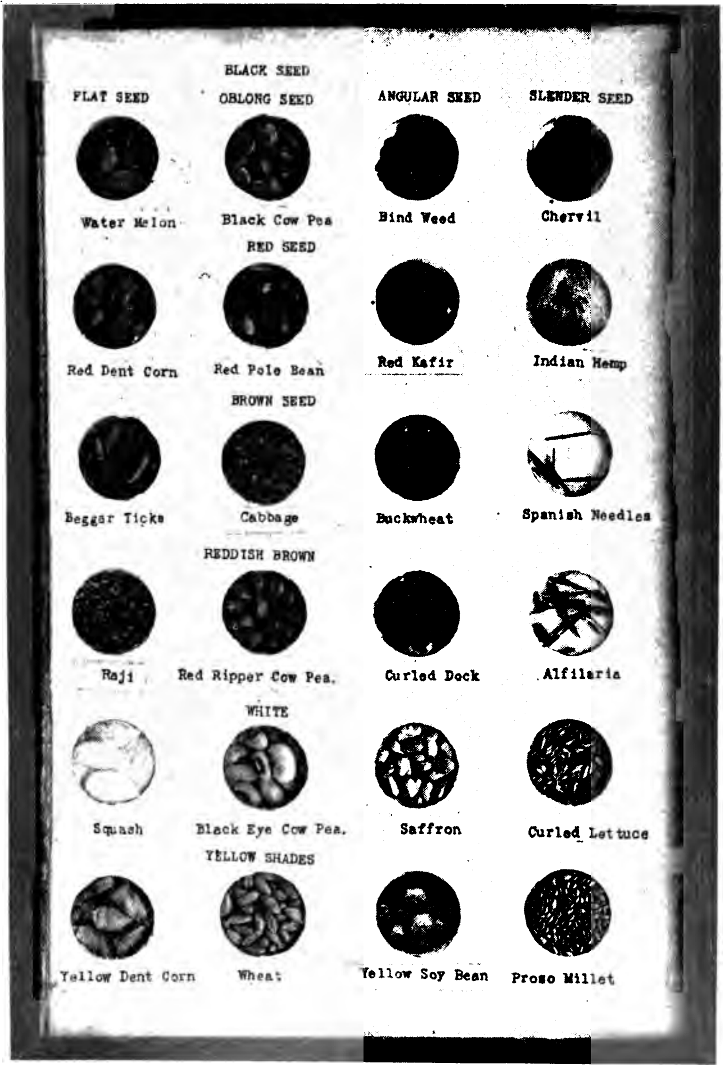


FIG. 49.—A reference collection of seeds to use in detecting impurities in seed samples. The seeds are placed in holes in Beaver board. Panes of glass are then placed on both front and back and are bound with black paper. (U. S. D. A.)

While the collection of seeds is being made, students may estimate the number of seeds borne by a single plant among the various kinds. Count the number of small seeds in a case, then the number of cases in a head or clump, and the number of heads or clusters on a plant. Large numbers of seeds are

Fig. 50.—A large collection of garden seeds should be made by the students and kept in the school. (U. S. D. A.)

borne by many plants because many of the seeds will be destroyed by the wasteful methods of distribution.

14. Weed Distribution.—Let the pupils each make a list of common weeds, as those they have collected, and others. Classify the weeds by the methods found for seed distribution: (1) Having burrs to cling to the coats of animals, as burdock and bidens. (2) Having down or hair to catch in the wind, as dandelion and milkweed. (3) Having wings to float on the air or water, as true dock. (4) Seeds which are edible and carried by birds, as plantain. Some of the weeds may appear in two lists and other classifications may also be made.

In connection with this exercise, the methods practiced by gardeners and farmers may be discussed. Weed seeds carried by animals find their way into their bedding and manure about the barnyard. These are spread upon the fields. Weeds growing abundantly in hay are likewise taken from the barnyard to other fields.

Gardeners often rot their barnyard manure for the purpose of killing weed seeds in it. This helps to keep their gardens free from weeds. Compost heaps are made by carefully alternating layers of manure and sod to prevent loss of plant-food during the rotting process.

15. Getting Pure Grass Seeds.—Add a few drops of mucilage to a little water. Use this to wet a piece of clean window glass. Sprinkle over it a thin layer of bluegrass seed such as you may wish to use on the school or home lawn. Hold the glass up to a bright light and examine the number of empty husks or glumes.

Several samples of grass seed from different dealers should be examined, as bluegrass and other chaffy grass seeds vary greatly in their value. Such seeds should always be examined in this or some other suitable way before purchasing. The weight per quart of seed gives a partial guide to its value. The heavy seed should always be preferred.

16. Oil in Seeds.—Get seeds from castor-oil plant, cotton plant, flax, buckwheat, soybeans, peanuts and other nuts. Examine these for the oil which they contain. Mashing some against writing paper will give it a greasy appearance. If convenient, get at a drug store a little alcanin (henna root in alcohol). Cut thin sections of the seeds and lay them on a piece of glass. Then apply a drop of the alcanin. It will stain the oil red and prove its presence. This is the standard test for fats and oils. Many seeds have enough oil so that it can be detected by rubbing between the fingers.

Seeds containing much oil are very valuable in commerce. The oils differ in character and are used for different purposes, as castor oil for medicine, linseed oil for paint, peanut and cottonseed oil for food.

The presence of oil in seeds protects them from the bad effects of weather from one year to the next.

17. Starch in Seeds.—**Remove some white starchy material from different seeds, such as corn, wheat, oats and buckwheat. Treat a little of each with a solution of rather diluted iodine. The dark purple color proves the presence of starch. Any other tissues may be studied at the same time, as in potatoes and dry corn stalks.**

Starch in seeds makes them nutritious as food for men and livestock. It is supplied by the plant for the purpose of nourishing the young seedling after germination. The starch is changed into sugar during germination. In this form it is dissolved and can circulate through the tissues of the young plant.

Starch is in the form of grains, each form being characteristic of the kind of seeds or plants in which they occur. By the use of a high-power microscope, the presence of different kinds of starch in human food, as flours and meals, can be determined.

18. Gluten in Seeds.—**Chew a few kernels of wheat until a mass of "gum" is formed. This part remaining is chiefly made up of gluten or protein matter of the wheat. The starch and oil have been removed by mastication. Flour is made from grinding wheat or other grains. The exercise may be varied by taking a sample of wheat flour and with water making it up into stiff dough. Wrap the dough in a cloth, then hold it in a pail of water and knead it until the white starchy matter is washed out of it. The remaining part is composed chiefly of gluten.**

Gluten is a valuable food content of grains and other seeds. It is also used for food by the plant when germination takes place.

Flours of different kinds may be tested as to the relative amounts of gluten by the plan used in this exercise. Wheat flour containing much gluten holds together better when made into the form of dough. Bread made from it will be "lighter" than if made from flour containing more starch and less gluten. Flour with little gluten is best for pies and other pastry, as the dough will be tender when baked.

19. Better Seed Potatoes.—When potatoes are being dug, let some student keep a record of the yields of good marketable potatoes

FIG. 51.—In selecting seed potatoes the hills that yield the most marketable tubers are the best. (U. S. D. A.)

from each hill. Potatoes from the largest yielding hills should be kept separate from the rest to use for seed. These may be put in sacks and a record of yield placed upon the sack or label. They may be stored in the usual way and used for seed next season.

Some hills of potatoes yield several times as much as others (Fig. 51). By selecting in this way, the future yields may be greatly increased. If the seed potatoes from the best hill are planted together in a row, or portion of a row, and labelled with a stake, the best may again be selected the next year. Thus, improvement may be kept up indefinitely. This method is a practical one for any farmer or gardener to follow (Fig. 52).

STUDIES OF FLOWERS AND POLLINATION

20. The Parts of a Flower.—Use some simple flower from the window box or garden. In the spring, cherry, peach, plum or apple blossoms may be used. Let each pupil examine carefully the stamens

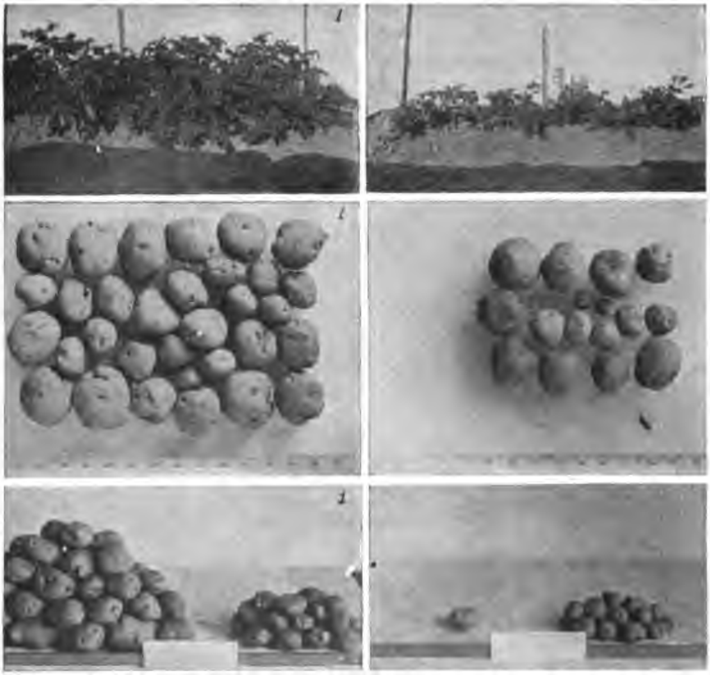


FIG. 52.—The left shows growth, yield, and marketable crop produced by well-selected seed. The right shows the contrasts from poor seed. (U. S. D. A.)

and pistil and see their relative positions. Are the stamens taller or shorter than the pistil? Can the pollen from the stamens fall directly upon the end (stigma) of the pistil? (Fig. 53).

Some flowers are of such form as to prevent much of the self-pollinating. The pollen from the stamens cannot fall directly upon the pistil, but must be carried by insects visiting the flowers for nectar or carried by wind. As insects visit the flowers, the hairs and coats of the body, legs, and wings may be covered with pollen grains and thus taken from flower

FIG. 53.—Large flowers, such as the poppy, may be used in studying the parts. (U. S. D. A.)

to flower. Some of it will reach the pistils in other flowers. Pollinating by this method or by the wind is called cross-pollinating. Some varieties of strawberries and many other flowers have no true stamens and the pollen must be carried from other flowers (Fig. 54).

21. Wind and Insect Pollinating.—Compare the blossoms of a showy flower, as one of the fruit blossoms mentioned in the above exercise, with the blossoms of grass or corn. Do any of them have fragrance? Do bees visit all kinds? Which are most attractive in color? Compare the pollen of the two kinds.

Flowers pollinated by the wind are usually not showy in color. They are usually green or yellowish green. The pollen is light and dry. There is no nectar, and the flower has no special odor.

Flowers pollinated by insects have one or more of these features: (1) The flowers are showy in color. (2) Some nectar is found in them. (3) They may have an attractive odor. (4) The pollen is heavy and sticky until very old.

22. Pollination of Corn.—Study the tassels and young ears, including the silks of corn. For this purpose some early sweet corn, such as Golden Bantam, may be grown in the window box during the winter, in time for study while school is in session. Large pic-

Fig. 54.—Strawberry blossoms. Those on the left are of two varieties, each having both stamens and pistils. Those on the right have only pistils. Varieties which have no stamens must be grown near perfect varieties so the pollen may be carried to them at blossoming time.

tures may be used if necessary. Shake the tassel on dark cloth or paper to find the grains of pollen. Trace the silks from tip to base and find their attachment. Each runs to its own kernel.

Many plants have the same plan for pollinating as found in the corn. Their pollen is in one part of the plant and the pistil in another. This requires the transfer of pollen by wind or insects. The corn plant is chiefly pollinated by wind. When the corn is in tassel, wind carries the pollen to the silks or pistils. A grain falls upon the sticky portion of a silk and forms a growth or elongation which reaches through the entire length of the silk. This is necessary in every case before the kernels can be formed on the cob. Samples of ears showing places where kernels were undeveloped should be brought to school and examined by pupils.

23. **Hand Pollinating.**—When plants are in blossom in the window or garden, select some containing both stamens and pistils. Just before they open, take a pair of scissors, or fine-pointed knife, and remove the stamens from a number of flowers, being careful not to injure the pistil or other parts. Cover these flowers with small paper bags or folded papers tied with a string or fastened with a rubber band about the stems. This is to prevent the air or insects from carrying pollen to these flowers. After a few days, when the pistils have developed, apply pollen from other flowers of the same kind by hand. This may be done by using a small soft feather or brush. Rub the feather on the stamens of flowers where you wish to collect pollen, and then rub it on the pistil of the flowers from which the stamens were removed. The bag is again placed over these flowers until the fruit or seed begins to grow. Then the bags may be removed. The time required will probably not be more than two weeks.

The methods described here are similar to those used by experimenters in plant breeding. The stamens of flowers are removed to prevent self-pollinating, and the pollen of desired kinds which they wish to cross upon those plants is brought by the hand method and placed on the pistils. Seed from such crosses may produce new and more valuable varieties. Among hundreds or thousands of trials, possibly only one or two improved varieties may be found.

CHAPTER VIII

THE SOIL AND ITS IMPROVEMENT

Soils used for gardens vary widely in their composition and character. Those which are of a medium nature, called medium loams, are best adapted to all kinds of garden crops. The sandier soils are better than the very heavy clays, but either of these extremes may be greatly improved by proper methods.

Certain crops are better suited to the heavy soils, while others prefer the light sandy soils.

Preparing the Soil.—In places where school or home gardening is to be taken up for the first time, the soil to be used should be prepared some months in advance, if possible. This will conserve the moisture, make a better seed bed and destroy many weeds and weed seeds. Teachers and committees intending to have a school garden soon should break up the soil either the fall before or the spring before. If the ground is in grass, composed of tough sod, and the plowing be first done in the fall, a cover crop may be sown. This may consist of winter rye with either crimson clover or winter vetch mixed with it. This may remain upon the ground all winter and serve the purpose of a cover crop. In the spring the ground should again be plowed and the growth turned under as green manure. If this first plowing be done in the spring perhaps a crop of corn or potatoes or other coarse growing plants may be grown. Tomatoes are sometimes used on the whole area. The cultivation of some such crop through one season will help to mellow the soil and get it in better condition for fine garden work to follow.

Liming.—Soil should be tested with litmus paper to see if it is sour. (See Exercise 5, Chapter X.) Test a sample of the soil with dilute hydrochloric acid to see if it foams. If it does, there is plenty of lime present. Nearly all soils will need liming. This may be done in the winter time or just after the spring plowing. Lime is very beneficial to most garden soils in a number of ways. (1) It aids in the decay of vegetable matter which has been plowed in. (2) It helps liberate plant-food in the soils, so that growing crops may use it. (3) It hastens the growth of bacteria in the soil. (4) Heavy clay soils are made more open and porous and are much better suited to garden work. (5) Light sandy soils are made more compact and hold moisture better. (6) The sourness

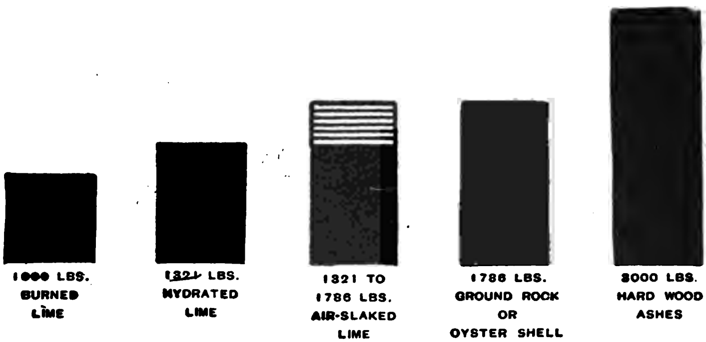


Fig. 55.—Equivalents in different forms of lime. When lime is used on garden soils, it is best not to grow potatoes or other root crops there until a year or two afterward because of the danger of scab disease. The danger is least when the carbonate is used.

of the soil is destroyed by the action of the lime upon the acids present. (7) Lime is a direct plant-food for members of the clover family, such as alfalfa, true clovers, peas, beans and others (Fig. 55).

There are a few garden crops on which the action of lime is not beneficial. Too much lime in the soil is found to injure watermelons, potatoes, beets and a few other root crops. This gives one reason why the crops in the garden should be somewhat classified and placed in definite sections of the garden, rather than having the several kinds of crops all found in all parts of the garden.

Green Manure.—Many soils, particularly in eastern and southern states, do not have sufficient organic matter. The rotting matter in soils produces humus, which is of great benefit to them. Green crops can be grown and plowed in for the purpose of forming humus. The action of this organic matter while rotting is to make the soil slightly acid in its reaction. The acid present sets up chemical action, which is

Fig. 56.—Crimson clover may be sown in gardens in August or September to grow through the winter as a cover crop. If turned under in spring the soil will be much improved. The crop is hardy except in the extreme northern states.

very beneficial to the soils. When the acid present is finally neutralized by the use of lime, any bad effects of the acid are overcome. By the combined use of the green manures and lime a soil may be made an active, productive one instead of an inert, non-productive one.

Green manures are frequently grown in the winter time, the seed being sown in late summer or fall. The crop may grow through the latter part of the season, on mild days during winter and in very early spring before the soil is in condition for tillage for garden crops. Thus time, which would otherwise be of no use in the growth of most garden crops, is used for the production of green manure to enrich the soil.

If the green manures are composed partly or wholly of plants of the legume family, they will gather nitrogen from the air and add it to the soil as they decay. Winter vetch and crimson clover (Fig. 56) are suitable annual legumes for use throughout the winter. Winter grains, such as rye and wheat, are also used abundantly as green manures, but these do not have the power of gathering nitrogen from the air. As green manures decay they not only add humus, but they add considerable plant-food which has been unlocked from the soil by their own growth. The decay of green manures in soil is so rapid in warm weather that the plant-food they contain is liberated very soon. In the school garden work, after early garden crops are grown, summer crops may be sown to be used later as green manures. Suitable legumes for this purpose are cowpeas and soybeans. If these are sown about the first or middle of June, in the latitude of New York or Philadelphia, they will thrive and gather large quantities of nitrogen with which to enrich the soil for future garden crops.

In localities where stable manure is difficult to obtain, green manures should be grown regularly, either through the winter season or during midsummer for the improvement of soils.

Cover crops, or green crops grown during the winter are beneficial in a number of ways. (1) They serve the purposes of green manures. (2) They prevent the leaching or waste of plant-food during the winter season. (3) They retard the washing away of surface particles of soils. (4) They help to cause rainfall to enter the soil more readily. (5) Their roots allow the entrance of air, thus causing soils to dry more quickly for early spring gardening. (6) They prevent the blowing of soils.

A good maxim among gardeners and farmers is "Never let the soil be bare." As soon as one crop is taken off another must go on, even if that crop is not to return any money directly. Cover crops are used in winter and catch crops in summer.

Humus.—As green manures and other forms of organic matter decay in soils they form a substance called humus. It gives the soil a blackish color. Dark-colored soils in most cases have humus in them. Newly cleared woodlands are dark in color because of the decay of leaves, roots and twigs of the former forest. Leaf mould found in forests is largely humus. The richness of such newly cleared lands is proverbial. But the farmer and gardener can plan a careful system by which organic matter is constantly added in the rotation of crops. Materials such as weeds, stubble, roots, vines, leaves and special green manure crops should be plowed in and never burned. Humus improves all soils and increases their productivity. It will absorb and retain more moisture than any other part of the soil. This is a benefit of greatest value to sandy soils. Clay soils are loosened by it, thus helping the circulation of air and moisture. Clay with humus present is less likely to clod and crust. The texture and structure of the soil is much helped, drainage and ventilation are improved and roots will feed to a greater depth. Humus is the main immediate source of nitrogen, and when the humus is being formed other plant-foods are liberated for the use of crops.

Barnyard manure is used on nearly all farms and crops as the chief means of improvement. In nearly all school gardens well-rotted manure is preferable to coarse manure.

The benefits of manure are: (1) It adds the three main fertilizing elements for plants, *nitrogen, phosphoric acid* and *potash.* (2) The vegetable matter contained in the manure is a great source of humus. (3) The soil is given a better physical condition. (4) It becomes a better home for soil bacteria. (5) Chemical changes are set up which are of benefit to the soils and gardens.

The value of stable manure depends largely upon the care with which it has been handled. The liquid manure should all be well absorbed by litter. Manure which is saved for future use should not be placed in large heaps to heat. The heating destroys much of its value. Neither should it be placed where much water, as from the roof of a barn, may wash out the plant-food; the nitrogen, which is most expensive, is lost quickly.

Compost.—Young gardeners should early learn to make a good compost. By this means manure is allowed to rot under very favorable conditions, and is in good condition for use in gardens, flower beds, hotbeds and greenhouses. A compost heap is made by spreading a layer of barnyard manure, then a layer of tough sods from a meadow, or a layer of leaves. On each of these two layers is sprinkled some lime or wood ashes. The layers are repeated until the manure is all in a compost. Rainfall will usually be sufficient to prevent the compost heap from heating, and will allow the rotting to continue gradually. The layers of sod or other fibrous matter, such as leaves or straw, alternating the layers of manure, save much of the plant-food from leaching out.

Weed seeds, which are usually abundant in all stable manures, are usually killed in a compost heap. During the process of rotting the bulk of the manure heap is greatly reduced during rotting; the plant-food is unlocked; the injurious effect which fresh manure has on such crops as potatoes is much reduced. Good gardeners usually keep a compost heap in a corner of the garden ready for use at all times. Fresh, coarse manure is often placed in the bottom and the rotted portions of an old compost heap are thrown on top. The coarse portions become rotted before they are needed for use in the garden.

1. Care of Manures.—Nearly fill a leaky pail with barnyard manure. Pour over it enough water to fill the pail. Stir it a little, if possible. Catch the drain water below. Use this in watering one box of plants in the window or one plot in the garden. In each case, leave a box or plot for comparison, which does not have the manure water, but is kept well watered otherwise. After a few weeks notice the difference in growth of the plants so treated. The experiment may be varied by using a large tub or barrel which holds water well. The manure and water may be stirred together, and as water is wanted for the garden the liquid is dipped off above the manure.

Gardeners frequently keep a "manure barrel" for use in watering such plants as lettuce, cabbage, celery and spinach, when they wish to force the growth. The liquid takes plant-food from the manure and stimulates the growth of the garden plants.

The fact that water will take plant-food out of manure shows the need of keeping a shelter over manure piles when stored in the barnyard. Loss of manure by the leaching of rain-water through it is one of the greatest losses on farms where stock is kept (Fig. 57).

Plant-food in barnyard manure, when compared with market prices of commercial fertilizers, is valued by the U. S Department of Agriculture (Farmers' Bulletin No. 192) a follows: From the barn of a horse, in a year, average $27, cattle, $19; hog, $12; sheep, $2.

Manure, as it is too frequently stored, loses from one-third to one-half of its plant-food. This greatly reduces its value.

A ton of manure from each of the farm stock would be valued in this order: Poultry, sheep, pigs, horses, cows.

Commercial fertilizers are used as a direct means of feeding plants with the plant-food which may be lacking in any soil. The most precious food elements are nitrogen (N), phosphoric acid (P) and potash (K). Soils are apt to become weak in any one or all of these plant-foods. They are washed out by rains and taken out by the growth of crops.

Very few other plant-foods need give a gardener much concern, as they are usually present in garden soils.

Commercial fertilizers are purchased in great abundance in the eastern and southern states and for special crops in other sections. Millions of tons are purchased for use each year. The application of commercial fertilizers as a rule is of no

FIG. 57.—Manure for gardens should be well rotted, as it will then contain less weed seeds; but it should not be allowed to leach in the weather. (U. S. D. A.)

permanent benefit to the soil itself. The more permanent amendments for soils are barnyard manure and green manure.

Commercial fertilizers vary in their composition and are valuable in proportion to the amount and kind of the three main foods contained in them.

Nitrogen is the most expensive fertilizer, and soils are more commonly in need of it. Yet this element may be obtained freely from the air by the continuous growth of legumes. As fertilizers containing nitrogen become available for plant growth, they are soluble in water and are easily washed out by rains. For this reason the application of such fertilizers should be made while the plants are growing, or when the plants are ready to make immediate use of them. Some fertilizers contain the nitrogen in the form of animal and vegetable compounds. Such is the case with fertilizers derived from meat scrap, dried blood, cottonseed meal, tankage and others. In these the nitrogen may not be ready for plants to make immediate use of it. The waste will be less, but the growth will not be so quickly stimulated. If nitrate of soda or sulfate of ammonia be applied, the nitrogen contained in them will be more quickly available for the plants, and the growth will be more rapid from the start. If these latter forms be used before the plants are started, some loss would take place.

2. Effect of Nitrogen.—In two window boxes or cans containing growing plants, study the value of nitrate fertilizer. Place one teaspoonful of nitrate of soda in a quart of water. Stir until dissolved. Label bottle and use this to water one box or can of plants, the other being supplied with pure water. After a few weeks of this treatment some difference in their growth should be observed.

Nitrate fertilizer tends to increase leaf growth and retard the formation of blossoms and fruit. In the garden, such plants as lettuce, celery, cabbage and spinach will be greatly aided by the use of nitrate fertilizer, because the stem and leaf growth is desired. Young fruit trees should be fed abundantly with fertilizers rich in nitrogen. When they reach bearing age, less nitrate should be used. Then, potash and phosphoric acid should be given in excess. Nitrogen produces dark green leaf growth; phosphoric acid produces stem and root growth and gives strength to the whole plant; potash checks leaf growth and causes the early formation of fruit.

3. How Much Nitrogen to Apply.—Select four cans with perforated bottoms. Nearly fill them with samples of garden soil which you wish to test. Have growing in these, corn or any other garden plants you wish to use where the samples were taken. Can No. 1

is to have no fertilizer and is called the "check" can, to be used for comparison with the others. No. 2 is to be watered with nitrate of soda solution made by dissolving one teaspoonful in a gallon of water; No. 3 one-half as much as No. 2, and No. 4 one-fourth as much as No. 2. After a few weeks' trial, determine which amounts of nitrate suit this kind of soil best. In each case, when the amount of fertilizer mentioned has been used, do not use any more, but continue to use clear water.

Soils which have an abundance of organic matter or of other nitrogenous material do not require as much nitrate to produce the best plant growth. The rate of application mentioned in this exercise for can No. 2 is approximately 500 pounds per acre, or about six ounces for a ten-foot row of the garden.

This test and a number of other fertilizer tests should be made with samples taken from gardens, so that the gardener may know how strong, and what kind of fertilizer to apply.

Phosphoric acid is found abundantly in nature in combination with lime and other materials. Phosphate rocks are found in deposits in South Carolina, Florida, Tennessee, Utah, Idaho and Wyoming. This rock is used as fertilizer because of the phosphorus which it contains. The rock is sometimes ground very fine and applied to soils directly. In this form it is commercially known as ground rock phosphate or "floats." It yields its phosphorus to plants very gradually and remains in the soil for years. A second and perhaps more common form of using the phosphate rock is to grind it very fine, and then treat it with sulfuric acid, which is called "acid phosphate," or "superphosphate." It may contain as much as twenty per cent of phosphoric acid, but more commonly contains fourteen to sixteen per cent. About four to six ounces of high-grade acid phosphate will be enough for a single garden row ten feet long.

Bones contain phosphate. Fertilizers containing bone are by-products from slaughter-houses. Bones and the various other wastes are thrown into a tank and the grease extracted. That which remains is called bone tankage. It is usually ground very fine, treated with sulfuric acid and dried. Some nitrogen is usually found in bone tankage because of the waste meat which it contains. Pure animal bone fertilizer contains, on an average, four per cent of nitrogen and twenty per cent of phosphoric acid. Fertilizers that derive their phosphate from animal bone are usually more expensive than those derived from phosphate rock, even when the composition is taken into account.

4. Phosphorus.—Common friction matches have phosphorus mixed with sulfur and other materials. Moisten the head of a match and rub it a little, being careful to not touch it with the finger-nails. The white fumes which appear are caused by the phosphorus in the match uniting with the oxygen in the air. These white fumes are phosphoric acid—exactly the same material found in fertilizers (P_2O_5).

Phosphoric acid is one of the three or more main ingredients which we apply to soils in commercial fertilizers. Nitrogen, phosphorus and potash are always found in complete fertilizers. Lime is sometimes present. Phosphoric acid or mineral phosphate in fertilizers is obtained from phosphate rock, ground bone, bone tankage, fish scraps, and other sources.

5. Making Phosphoric Acid.—Put a few teaspoonfuls of ground phosphate rock in a drinking glass or large test-tube. Pour over it about the same amount of strong sulfuric acid. Stir these together. An important chemical action will take place. The lime present in the rock is taken by the acid, and a mineral acid is left in the tube. This is the phosphoric acid of commerce.

The method used in this exercise is exactly similar to that used on a commercial scale in the manufacture of phosphoric acid as a farm and garden fertilizer.

The phosphate rock for these exercises may be obtained by asking for a sample from any fertilizer company or from local dealers. The sulfuric acid may be obtained from a drug store or high school laboratory. It is the same acid as that used in testing milk samples.

6. Testing for Phosphoric Acid.—Put a little finely ground phosphate rock in a glass of water to see if it will dissolve. In like manner try a little ground bone in another glass. To see if any is dissolved, pour in a little clear lime water. If any phosphate is dissolved, the lime water will cause a white cloudy appearance.

The question naturally arises: "Will rain dissolve bone and phosphate rock when they are in the soil?" Plant-foods which do not dissolve somewhat when treated with water or very weak acid are considered insoluble and are not readily available for use by plants. Common phosphate rock is found upon the market at a price very much lower than acid phosphate. It is used for field crops rather than for gardens, as it has a less stimulating effect. It contains about twice as much phosphorus per ton as acid phosphate. A common name of phosphate rock is "floats." It should be ground very fine before applying to soils.

Potash is more commonly found in moist soils. Sandy soils and those which have been farmed for a long time are most deficient in it. Wood ashes contain much potash and are good as fertilizer to use on gardens. The largest source of potash is in the form of mineral salts, found in some parts of Germany. These may be ground fine and placed directly on the soil. More commonly perhaps they are refined or concentrated. The two main commercial forms of the rich potash salts are muriate of potash, containing fifty per cent of potash, and sulfate of potash, containing about forty-eight per cent of potash. These forms are soluble in water and easily absorbed by plants.

7. Wood Ashes as Plant-food.—Place a peck or more of wood ashes in a vessel with a hole in the bottom. A leaky pail will serve the purpose. Pour over the ashes enough water to show above the top. Stir them a little with a stick, if possible. Catch the water which runs through below, in a pan or other vessel. Examine this water closely. Test it with the litmus paper mentioned in a preceding exercise. It turns litmus blue, and is alkali. Between the fingers it feels soapy. It is really "lye water."

This exercise shows one important plant-food in the ashes—potash. There are several different kinds of plant-food in wood ashes. For this reason, ashes should be saved in a place where the rain-water will not take away the food by leaching. The forms of mineral matter which the trees take from the soil while growing may be carefully saved and returned to the soil in the form of ashes.

The test with the litmus paper proves that the ashes will correct the sour or acid condition of soils.

Schools or homes burning wood may spread the ashes throughout the winter season on the land where the garden is to grow. The leaching of all soluble plant-food will be directly into the soil.

How to Buy Fertilizers.—The real value of any commercial fertilizer is based not upon the brand, but upon the kind and form and the amount of elements contained in the mixture. Good gardeners sometimes buy fertilizers that have a low price per ton. These are invariably more expensive sources of plant-food than those more highly concentrated. The low-grade fertilizers contain more make-weight or poorer materials. A gardener prefers high-grade fertilizers containing good forms of plant-food. Such cannot be sold for a low price. The price alone cannot be taken as a safe guide as to the effect that a fertilizer may have upon the crop. This is measured by the kind and form of materials in the mixture.

Home mixing of fertilizers has become a more common practice among gardeners. The elementary forms of plant-food are purchased separately and mixed as desired for the special crops. The mixing is done on a smooth floor with a shovel, just as concrete materials are sometimes mixed. For a good medium loam early garden crops may be fed with commercial fertilizer, as follows:

Nitrate of Soda	250 lbs.
Ground Bone	100 lbs.
Acid Phosphate	550 lbs.
Muriate of Potash	100 lbs.

After these ingredients have been mixed, about 100 pounds per acre may be applied. For small gardens the quantity is reduced in proportion to the area, of course. One ounce of the above potash would be enough for a single row of the garden ten feet long.

8. Exercise in Home Mixing of Fertilizers.—Choose the fertilizer ingredients to be used in the garden. Separate ingredients should be obtained and the amounts are determined by the area to be fertilized. Make this a lesson in home mixing. Pour the contents of each separate sack of fertilizer on a smooth floor or mixing board. With a shovel crush the lumps, if any are found. Spread the first kind out level and place each of the others in level layers on top. The mixing is chiefly done with common shovels or hoes. By cutting through the several layers the different ingredients become mixed. A new pile is made by the side of the first, as the shovelling or hoeing is done. One person may use a rake on top of the new pile as it is being formed by other persons. A second and third shovelling over of the pile will make the mixture very perfect.

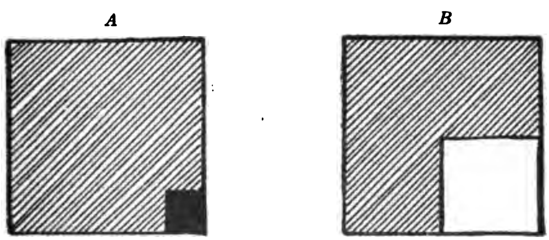


FIG. 58.—Each large square represents a ton of fertilizer. The proportion of valuable ingredients in a low-grade material is shown by the black corner, and the proportion in a high-grade material is shown by the white square.

The practice of home mixing fertilizers is recommended by experiment stations and many of the best gardeners and farmers. High-grade materials can be purchased from the leading fertilizer companies and often from their agents. The prices of these materials are more stable than those of ready-mixed fertilizers with registered or "patent" names. In buying special brands something is paid for the "brand." Many of them contain much filler or "make-weight" materials. The addition of filler usually reduces the price a little, but often the reduction is not in proportion to the amount of filler used. It is not good practice to pay freight and cost of hauling fertilizers containing filler. For these reasons low-grade fertilizers should seldom be used (Fig. 58).

9. Which Fertilizer to Use.—Prepare five cans of growing plants, as in the preceding exercise, and leave No. 1 as a check can. No. 2 is to be fertilized with one teaspoonful of nitrate of soda; No. 3 with acid phosphate solution made by mixing two teaspoonfuls with one gallon of water. No. 4 is to receive muriate of potash made by mixing one teaspoonful with one gallon of water. No. 5 is to receive all three kinds of fertilizer made by mixing the three in a gallon of water together. Note the comparative growth for several weeks and determine which fertilizer is most needed by that kind of soil for the plants grown.

The same trials may be made with all the kinds of garden soil available. Each may be tried with a few different kinds of garden plants. In the school garden, fertilizer trials of a similar nature may be carried on. Small plots for each fertilizer may be staked off, five feet wide and twenty feet long, or any other size desired. It is not difficult to determine suitable amounts of the different fertilizers to use in the trial. If such a plot (5 feet × 20 feet) were to receive one pound of any one kind of fertilizer, it would be approximately at the rate of four hundred pounds per acre.

Improvement by Tillage.—Implements have been so much improved that tillage is one of the commonest ways to put soil in proper physical condition to yield good crops. Tillage is of two main types: (1) Shallow, as with harrows and cultivators. (2) Deep tillage, as with a plow and disking machines.

The main objects of plowing are: (1) To turn under green manures and other vegetable matter, such as stubble, stalks, vines and weeds, to get them out of the way and to place them where they will rot to improve the soil. (2) To unlock plant-food by exposing particles to new conditions of heat, light, moisture and air. (3) To help prepare the soil as a seed bed. (4) To deepen the water reservoir and make the moisture conditions more perfect. (5) To loosen the soil and allow of better shallow tillage.

Depth of Plowing.—If soils be rich and black to a great depth, the plowing may be as deep as desired. In shallow soils, where the poor soil is close to the top, the depth of plowing is limited. Very little, if any, poor soil should be turned up at any one time of plowing. In such cases the depth of the soil may be greatly increased by plowing deeper each time. This increase should be very gradual—one-half inch or so at a time. If green manures or other forms of organic matter be plowed under each time the lower soil will be improved more readily and the plowing should become deeper and deeper. In soils which are very sandy with loose porous subsoils, there is much danger of plowing too deep, unless well-rotted manure or other similar material be added each time.

When the school garden is first being prepared the first plowing should be shallow. If there be a sod to kill, the second plowing, made perhaps a few months later, may be crosswise of the first, and made much deeper.

Shallow Tillage.—In preparing a garden, the common spike-toothed harrow, with adjustable or slanting teeth, is most commonly used. For heavy soils a disk harrow is very helpful. The Acme harrow is a good instrument as a pulverizer for clods and sods.

For cultivation between rows a fine-toothed cultivator is used. For most garden purposes, either at school or home, young people will find a one-horse cultivator, which is adjustable in width, a very desirable form. Wheel hoes are very useful when horse power is not to be used. Tillage between rows does not need to be deep for most crops, if the soil has been properly prepared in advance.

Bare Fallow.—In early spring, after the soil has been plowed, it should be harrowed immediately. Plowing done at a drying season of the year, either spring or summer, should be harrowed promptly to prevent the formation of clods. This plan will also preserve the moisture necessary for the future growth of plants. A period elapsing between the plowing of the soil and the planting of the crop is often spoken of as "bare fallow." During the bare fallow period the soil should be kept well harrowed. If at any time the soil becomes beaten together by heavy rains, it must be loosened up as soon as dry enough by the use of a harrow or cultivator. This is one of the important secrets of any gardening. Never allow the soil to become hard and crusty, and never allow it to pack for lack of prompt surface tillage.

FIG. 59.—Garden-pea roots showing nodules containing the numerous bacteria that enable the plants to use nitrogen from air.

Killing Weeds.—The bare fallow period is the best time to kill weeds. Weed seeds germinate from their coats at varying conditions of moisture, temperature, and depth below surface. Many of them will germinate soon after plowing. The first harrowing will kill these by breaking the sprouts, and bring other seeds into suitable conditions for germination. These sprouts are broken by the next harrowing and so on. Each harrowing kills large numbers of weeds too small to be seen above ground; thus the weeds which would otherwise be troublesome in midsummer are destroyed before the garden is planted. The use of a harrow for this purpose before planting time is a much better method than the use of a hoe or other hand tools after the garden is growing.

Other benefits derived from the frequent early harrowing of the garden before planting are found in the warming of the soil, the increase of bacteria, the unlocking of plant-food, the pulverizing of clods and the formation of a better seed bed for garden seeds.

10. Legume Nodules.—After peas, beans, or other legumes have grown to a height of five or six inches in window boxes, or the garden, a few plants should be dug with care to not pull the roots from the soil. Rinse the roots in water and examine for nodules (Fig. 59).

The nodules on legume roots of all kinds are the homes of friendly bacteria. These bacteria enable the plants of this family to secure nitrogen from the air in the soil about them. When nitrogen is thus obtained it aids the growth of the crop itself and also supplies nitrogen to other crops which follow in the same soil.

Unless nodules are present, the plants are not obtaining nitrogen from air. Many soils do not contain the bacteria required by different legumes for this purpose. It is often found necessary to supply the bacteria by some process called inoculation.

11. Inoculating Soil for Legumes.—In two window boxes or two perforated cans, or two similar plots in the garden, have the soil and conditions alike with this exception: Let one be inoculated with alfalfa bacteria. This is done by spreading on the surface of the soil a little soil from a field or plot where alfalfa has grown successfully, having nodules while growing. The inoculation soil is to be raked into the surface immediately when applied, to avoid exposure to bright sunshine. The sun would kill the bacteria. A very small quantity of soil is enough. Inoculation may also be done by using a culture obtained by writing to the Bureau of Plant Industry, Washington, D. C. The directions which come with it should be carefully followed. After inoculating one plot or box, each of the two should be sown to alfalfa and allowed to grow until a few inches high. Then a few plants may be dug and the roots washed and examined for nodules. The growth in the two plots should be compared. Does this indicate that inoculation is helpful in the soil you have?

Some soils need inoculation for certain legumes, while other soils have the bacteria present in abundance. Nearly all good garden soils have plenty of bacteria suitable for such legumes as peas, beans, cowpeas, and the common clovers. Many soils require inoculation for alfalfa, soybeans, and some few require it for red clover, some varieties of beans, and others. In this experiment another legume may be used instead of alfalfa. The principle may be brought out by heating the soil in the cans or boxes by placing it in an oven hot enough to kill all bacteria present. This will make the inoculated plot show a marked difference in growth for any legume which may be used. With peas, for example, the soil in one can may b sterilized with heat and the other not sterilized. The growth will then show the bacteria present in the latter but not in the former.

12. **Lime for Legumes.**—Prepare two similar areas as in the preceding exercise. The soil for this is better if it is a heavy clay or very black soil. If, when tested with litmus paper it is sour, so much the better (see exercise with litmus paper, Chapter X). Apply a very light sprinkling of fine lime over the surface of one plot and rake it in. Then grow some kind of legume such as clover or alfalfa until it is a few inches high. Observe the difference in growth on the two plots.

Does the growth show any marked difference? Is the application of lime beneficial for the legume in this case? The exercise may be tried with several different legumes, as beans, peas, soybeans, cowpeas, and others. It may also be repeated with different types of soil to determine whether all kinds of soils in the neighborhood are benefited by the use of lime.

13. **Amount of Mineral Matter in Plants.**—Carefully weigh a few ounces of very dry wood. Then place it on a stove shovel in the stove and burn it, being careful to save all the ashes on the shovel. Weigh the ashes with the most delicate scales available. Nearly all of the mineral matter of the wood is left in the ashes.

The mineral parts of the plant come from the soil. The exercise shows how small a part of the plant's food comes from the soil. Nearly all of the remainder of the plant's food comes from the air. It is usually considered that our farm crops take 95 per cent of their gain in weight from the air. The other 5 per cent is made up of the ash or mineral matter which they get from the soil. This 5 per cent is absolutely necessary. Indeed, as this amount increases, the increase is multiplied many fold by the part taken from the air. We consider the portion taken from the air inexhaustible. This illustrates the need of increasing the mineral food of plants up to the greatest amount which they can use.

14. Soils Retain Plant-food.—Tie cloths to cover the large ends of several lamp chimneys. Pack each chimney nearly full with garden soil and stand each in a separate dish. Pour liquid manure into one, ammonia water into a second, lime water into a third, and water containing phosphoric acid into a fourth. After the water passes through in each case, note such changes as can be observed. The liquid manure will probably lose its characteristic color; the ammonia water may lose its odor; that which passes through should be tested also with litmus paper. Test also the lime water with litmus paper. Test the water from the fourth for phosphoric acid by pouring lime water into it, as suggested in another exercise. If the phosphoric acid passes through the soil of the chimney, it will cause a white cloudy appearance when treated with lime water. The exercise may be extended by the use of another chimney and a trial with lye leached from wood ashes.

Some kinds of soil are more retentive of plant-food than others. Light sandy soils do not hold plant-food as well as the heavy clay loams. Plants are able to get the food from sandy soils more readily than from clay. That is, sand yields to the plant more nearly all it has.

15. Rains Remedy Over-fertilizing.—In two cans of good garden soil plant beans or corn. The cans should have good drainage in the bottom. When the plants are up a few inches, water one of them with an excess of nitrate of soda or some other fertilizer. Common salt solution may be used instead. When the plants begin to show signs of wilting, stop this treatment. After one day, note the difference in appearance between the plants in the two cans. One should be healthy and vigorous, while the other is drooping and dying because of the over-feeding or the strong salt solution. Before the plants are dead, water this can abundantly with pure water, using rain-water if available. Let the surplus water drain through the holes in the bottom of the can.

When too much fertilizer has been applied to crops in the garden or field they are more apt to suffer because of this extra fertilizer if the weather is dry. If heavy rains come, the plant-food is diluted and its wilting effects are reversed. When enough water is present the food may be taken readily into the plants.

Care should be taken to never over-feed the plants unless an abundance of rain or irrigation water is ready for use by the crop. In dry climates, soils containing much salt near the surface are found. These are called alkali soils. These salts retard the growth of plants. They may be removed by installing under-drainage.

Reclaimed salt marshes along sea-shores may have an excess of common salt left from sea water. Many kinds of plants cannot be grown there until the rains of several seasons have washed out the surplus salts.

16. Minerals in Soil Water.—Fill two clean quart cans with water, one with clean fresh rain-water, the other with water from a well or spring. Set them on a stove and boil until dry. Note any difference in the remaining matter in the cans.

If the well-water is "hard," it will leave much white sediment on the sides and bottom of the can. This is observed by all housekeepers in tea kettles. The other can will probably show no such sediment. If anything remains in the can, it will probably be some dark material, as dust washed from the air or roof by rain in falling.

All water from springs, streams or wells dissolves mineral matter of several kinds from soils. Such water may contain a large enough supply of minerals to materially aid the growth of plants.

17. Solubility of Lime.—Slake a lump of lime by placing it in an open vessel with water enough to one-fourth cover it. As it begins to heat and crumble, stir it and keep the whole lump moist. As the slaking continues, gradually add a little more water until the heating ceases. Then add about twice the amount. Stir well and put aside to settle. Carefully pour off the clear water into a bottle having a good stopper. Test the water with litmus paper to show it is "alkali." Save a supply for use in other exercises.

When burned lime is slaked and spread upon soils, it is readily dissolved by rain-water and carried down into the lower soil. For this reason, lime should be placed on top of the plowing and not plowed under. Its tendency is to move downward with the soil water.

The alkali test shown with the litmus paper shows the power of lime water to "sweeten" sour soils.

18. Fertilizer Samples.—Let several students who have extra time write to a number of fertilizer companies, asking for samples of both raw materials and mixed fertilizers for use in the school. Some of these will come in nicely labelled glass bottles, while others may be sent in envelopes or small packages. These should be transferred into bottles as uniform as the students of the school can find about their homes. Suitable things to ask for are: Nitrate of soda, sulfate of ammonia, high-grade tankage, low-grade tankage, dried blood, fish scraps, phosphate rock (called "floats"), bone meal, acid phosphate, steamed bone, basic slag, sulfate of potash, muriate of potash, kainit, unleached ashes, hydrated lime, ground limestone, gypsum, ground oyster shells. These samples should be preserved for use in a number of exercises and for illustrative material in the study of fertilizer problems.

CHAPTER IX

IRRIGATION AND DRAINAGE

IT is necessary to have the right degree of moisture in soils to secure the best growth of plants. If it be too wet at certain seasons or too dry at other times the growth of crops is retarded. Tillage will do much to control the amount of moisture in garden soils.

It is desirable and profitable under certain conditions to have some system of drainage or of irrigation, or both.

IRRIGATION

It is not necessary to give any reason or argument for irrigation of crops in sections where the climate is very dry. Much work along that line is being done by the Reclamation Service of the United States and by large corporations encouraged by certain favorable laws.

Irrigation in Humid Regions.—Plant growth is dependent upon the soil moisture being in just the right condition throughout the growing season. Gardeners and farmers are accustomed to depend upon rainfall to maintain the proper soil moisture in humid climates. Every summer there are one or more prolonged periods during which the rainfall is so slight that crops of all kinds suffer greatly and plant growth is checked. Indeed, plants are often killed by dry weather. It is because of these drouthy periods in humid climates that irrigation of some kind is necessary to maintain the best growth of garden crops. When plants are compelled to suffer from lack of moisture at any time, the loss is not merely during the drouth, but the plants may never recuperate and regain their full vigor or growth after the drouth is broken. To avoid both of these losses irrigation is often found advisable and profitable.

Not all crops will pay for irrigation. Some crops are much more profitable than others because of market conditions and other influences. In regions where drouths are not too severe, there are many crops which it will not pay to irrigate. Any gardener raising a few special crops must determine for himself whether these crops can be irrigated with profit. For home and school gardens, the element of profit is usually not one of vital consideration. If some plan of irrigation is installed, all parts of the garden, whether at home or at school, will be given the benefit of it.

The water supply is obtained from such sources as dammed streams, wells, elevated springs, waste water from dwellings and barnyards, rain-water basins or tanks. Very small streams are sometimes easily dammed in narrow cuts so as to impound a sufficient supply of water to carry on considerable irrigation. Wells that are not too deep often supply plenty of water for irrigating gardens and large fields. The overflow from troughs where stock are watered may be used directly upon the garden.

Water is raised or forced to the point desired for irrigation purposes in a number of different ways. In some cases gravity carries the water from elevated springs to the garden. Such cases are rare. Windmills are perhaps more commonly used than any other method. The water is pumped to an elevated tank and from here it is conducted as desired. Water pumps may be operated by water-wheels, gasoline engines, steam engines, and even by hand or horse power. Hydraulic rams are frequently used where a slight fall is found in a stream, sufficient to operate the ram. A constant stream of water is thus sent to a reservoir or tank higher than the garden and from there it is used for irrigation. Of these different methods the cheapest are perhaps the windmill and hydraulic ram.

Conveying the Water.—The simplest method of conveying the water from any supply provided is by hand. This is so laborious, however, that the watering or irrigation is usually neglected. In school gardens it is perhaps the most practical method, but where possible some quicker and easier plan should be used. A garden hose (Fig. 60) is not too expensive for use where a constant water supply is available. In cities or villages where the water system comes near the garden, a hose is by far the simplest and most practical method of watering. Special pipes are sometimes installed to conduct the water

Fig. 60.—Active in beautifying vacant lots. Irrigation is here done by the furrow method and water hose. Los Angeles. (School Garden Association of America.)

from the tank or directly from the pump. These pipes are installed on one of three plans:

(1) The pipes may be supported on posts high enough to be out of the way for the plowing, cultivating and other garden work. This is known as the overhead system (Fig. 61).

(2) The pipes are laid on the ground and are so arranged as to be as little in the way as possible. The head pipe may run across the end of the garden and lateral pipes follow the rows.

(3) The water pipes are placed under the ground low

enough not to be in the way at plowing time. Ascending pipes come to the surface at intervals. In all three of these plans, faucets may be placed where desired for the attachment of garden hose. In the first two plans, the water may be thrown by the use of special nozzles directly from the water pipes without the use of hose.

Ditches or flumes are sometimes used to convey the water

FIG. 61.—Overhead irrigation system for children's gardens of the National Cash Register Company, Dayton, Ohio. The nozzles are three feet apart along each pipe. A small garden may have only one pipe through the center. (Photo from Children's Flower Mission, Cleveland.)

to various points of the area to be irrigated. From there the water may be distributed in smaller ditches or furrows or if the area be flat a flooding method is sometimes followed (Fig. 62). The actual watering about the plants is by one of three ways: Flooding, seepage from furrows and small ditches, and surface sprays. In proportion to the amount of water used, the spray methods are most wasteful. This is because so much of the water is lost by evaporation, and the surface of the ground is packed by the fall of water. When plants are watered by hand it is better to pour the water on the soil in such a way as to cause it to enter immediately, rather than to sprinkle it over the surface and pack the particles together.

After-treatment.—In any system of irrigation it is advisable to follow up the watering with the proper kind of tillage. If this is not done much of the advantage gained from irrigation is lost by the rapid evaporation following the work. If a soil mulch is quickly established by the use of small-shovelled cultivators or similar implements, the evaporation of water is greatly checked. In a small garden a common garden rake serves this purpose well.

Fig. 62.—Here the irrigation water is conducted to the edge of the garden in a wooden trough or flume. It is then conducted along shallow furrows between the rows of plants. (U. S. D. A.)

Liquid Manure.—A favorite form of irrigation long practiced by gardeners is to apply liquid manure during dry weather. Some gardeners provide a large tank in which a load of stable manure is soaked in several barrels of water. Any boy can install the same plan for his home or school garden by the use of a tub or barrel of water with a few forks of stable manure in it. This liquid manure is very stimulating in its effects upon plant growth. It is rich in nitrogen and may be used when leaf growth of any form is most desired.

DRAINAGE

Too much water in the soil at any time during the growing season is as bad as, or worse than, too little water, but the removal of surplus water is not the sole purpose of drainage. If water stands too close to the surface during wet seasons, drainage will help the soil in the following ways:

(1) By removing surplus water at those times.

(2) By deepening the feeding area for plant roots (Fig. 63).

(3) By admitting air and aiding the ventilation of the soil and roots.

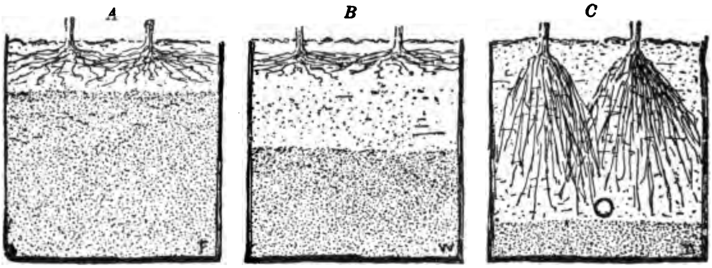


FIG. 63.—Underdrains encourage roots to feed deeper. *A* shows water just under the roots in wet weather. *B* shows the roots far above the water during drouth. *C* shows the roots and the water as deep as the tile drain.

(4) By allowing the roots to grow deeper and reduce the suffering at time of drouth.

(5) By raising the temperature of the soil.

(6) By increasing the chemical action.

(7) By aiding tillage.

When water is carried to greater depths by drainage, air and warmth follow. These are important factors in making plant-food soluble and increasing the growth of plants. If the school garden is not properly drained, a good lesson in soil drainage should be taught. A practical demonstration can be made by the installation of the drains, under the observation and perhaps by the aid of the pupils present.

Kinds of Drainage.—Most fields are fairly well drained naturally. In contrast with these there are others which must be drained artificially. This may be done by (1) open ditches; (2) blind ditches, partially filled with stone, rails or other material and then covered with soil; (3) tile drains, the tile being properly laid in the bottom of the ditch and then covered with soil.

Covered Drains.—There are a number of obvious reasons for having drains covered instead of leaving the ditches open: (1) There is no waste area occupied by the drain. (2) It is much more convenient in crossing from one place to another. (3) It drains the soil better. (4) It is more permanent, as the sides of open ditches cave in and fill up. (5) No weed strip is left on the place.

Installing Drains.—The value of underdrains depends upon the free passage of water, and care must be taken to install them so that no sediment will form in the pipes. A good uniform fall is desired and the drains must not be placed so deep as to not quickly receive the water after heavy rains. For special instructions regarding the installation of drains the student is referred to U. S. Farmers' Bulletin 187, "Drainage of Farm Lands."

Cost of Drainage.—The actual cost in money and labor for the installation of a system of drains is much less than the beginner is apt to think. The benefits derived from the place which needs draining are usually much greater than the cost, and the increased returns in one or two seasons will more than cover the cost. The questions for consideration are: Does the place really need drainage? Can it be drained? Will the crops be much increased, or can crops that are more profitable be grown as a result of the drainage? What will be the total cost? Any one carefully answering all these questions about his place will need to give it enough consideration to determine whether the drainage will pay or not.

CHAPTER X

EXERCISES WITH SOILS

ANY one desiring to really understand the principles of soil management will find the task much easier if a few experiments are tried. For this reason a series of simple exercises are suggested in this chapter. The application of the lessons to the garden practice will not be difficult.

1. Soil·Sampling.—A spade may be brought by one of the pupils. A sample from any field may be taken by digging a hole to the depth desired. The sides of the hole should be as nearly vertical as possible. Place a folded newspaper in the bottom of the hole to catch the sample. With the spade, slice off a uniformly even layer of soil from one side of the hole, remove this, crumble it nicely, or, if convenient, sift it with a simple sieve. This may be made of wire netting. The soil may be saved by placing it in a tin can, cigar box, or wide-mouthed bottle. If the sample is to be tested later for moisture, it should be placed in a tightly closed vessel until tested.

Soil samples are frequently taken for the purpose of having them tested by Agricultural College experts, or others, to indicate their suitability to certain special crops. The sample should be taken to the depth of the good soil. If a study of the subsoil is to be made, a sample of that may be taken separately, and in a similar way. Too much care cannot be exercised in taking a sample, as a fair sample is necessary. If the sample had too much or too little of the very top it would not be fair.

Samples may be taken of many parts of the same field and studied separately or made up into one composite sample.

2. Testing for Moisture.—Simple spring scales or family scales may be loaned by one of the parents. Weigh one pound of soil from a sample which has not been exposed to the air since it was taken in the field. Spread the soil in a stove shovel or in a large wide-mouthed can. Place it on a stove or heater where it will dry rapidly but not burn. The soil may be turned over or stirred carefully in a few hours. After a day or more it should be weighed again after cooling, and the loss in weight determined. This loss is due to evaporation of the capillary water.

Some soils naturally hold much more water than others. The character of the soil and its value for certain crops may be partly determined by testing for moisture.

3. **Testing for Organic Matter.**—Weigh eight ounces of soil which has been dried in an oven or otherwise. Put this on a stove shovel and place it in a fire or on a good bed of coals. It will glow and particles will be burned away. It may be carefully stirred several times so that all parts will be exposed to the air over the fire. If the fire is hot the burning process is completed in a few minutes. Then re-weigh the sample. The loss in weight is chiefly due to the burning out of organic matter and humus.

The test for organic matter and humus is one of the most valuable tests to be made of any soil. It tells the gardener or farmer whether the soil is rich or poor; whether it will retain plant-food and moisture well. If several samples of different kinds are tested in this way the importance of the exercise is better understood. Soils from marshes are usually richer in organic matter than upland soils.

4. **Humus Prevents Baking.**—Fill three cans nearly full of soils differing as follows: (1) With heavy clay loam; (2) heavy clay loam mixed with one-fourth as much black humus soil; (3) heavy clay loam mixed with one-half as much black humus soil. Wet these all thoroughly and place them in a sunny window until dry. Then note the difference in baking and cracking effects.

Organic matter plowed into the garden or field forms humus and helps to prevent its baking and cracking (Fig. 64). The samples in this case should be examined thoroughly with the fingers to note the difference in pulverizing. The one containing most humus should pulverize most readily. A garden containing much humus is more readily kept in good tilth.

In garden practice it is found that soils containing well-rotted manure or other organic matter are less subject to the baking effects of hot winds and sun. Heavy rains do not pack them together so badly as heavy clay soils. Gardens are much improved by plowing under green manure grown for this purpose.

5. Testing for Sourness.—A few cents' worth of litmus paper may be purchased at a drug store. It usually comes in two colors, pink and blue. A sample of soil freshly taken is tested by placing a piece of the paper of each color in it. Cover the paper with some soil and press it until the moisture affects the paper. Be careful to avoid touching the paper with the fingers except at one end. If either of the slips changes color, the character of the soil is deter-

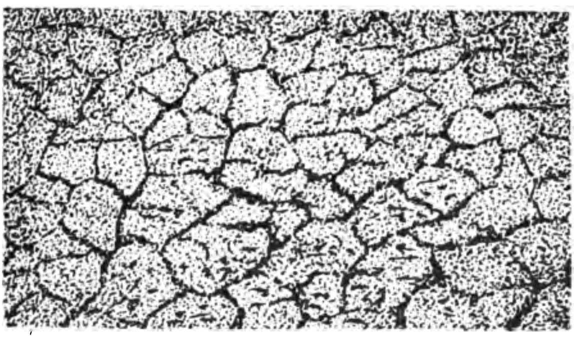


FIG. 64.—Garden soils should not be allowed to bake and crack either before or after planting.

mined. A change from blue to pink indicates sourness or the presence of acid in the soil. A change from pink to blue indicates that the soil has lime or other alkali present. If there be no change in color of either piece, the soil is "neutral," or nearly so.

For most crops, soils should not be acid in their action on litmus paper. If they be either neutral or show the presence of lime, they are suitable in this respect for most farm crops. The acidity of any soil may be corrected by the addition of lime.

6. Taking Soil Temperatures.—A twenty-five-cent dairy thermometer may be purchased at a drug store or from a dairy supply house. It should be made of glass without a frame around it. This

may be used in taking the temperature of the soil out of doors. A suitable use for this exercise would be in the early spring before planting seeds. Dig a hole with a spade as in taking soil samples. With a wooden peg or lead-pencil make a hole in one side of the hole made with the spade. The peg hole may be at any desired depth. Insert the bulb of the thermometer in this peg hole and with the fingers press the soil around the stem of the thermometer to exclude air. After waiting one minute, read the temperature before removing the thermometer from its position. It is well to take the temperature at a depth of three inches, six inches, and nine inches. The temperature of the air should also be taken.

Soils are warmed by the admission of warm air to them through the process of ventilation. In the springtime the air is usually warmer than the soil, and the soil is then usually colder at the greatest depth, because the warm air has not yet reached it enough.

Such seeds as radish, lettuce, peas, and the small field grains sprout readily in soil ranging in temperature from 50° to 70°. Corn, beans, cotton and beets sprout better in soils at a temperature of 70° to 80°.

7. Color and Temperature of Soils.—Fill two cans or two deep boxes with the same kind of soil, both moistened and packed alike. Cover one with a layer of very black soil or with soot from the stove. Cover the other with a layer of chalk dust or other white powder. Place these in a sunny window so the sun will strike them alike. After a few hours, insert the bulb of the thermometer in a hole made a few inches deep, with a peg or pencil, and read the temperature of each with the thermometer in place. If the experiment has been successful, the light-colored soil will remain cooler than the black one.

The experiment indicates that if color were the only difference between soils, the light soils would be cooler. Light-colored sand would be cooler than the heavy clay or black loam or humus soils. Observation and temperature tests prove the very reverse to be true. The effect of color is more than overbalanced by the porous character of the sandy soils which admit air readily, and warm air warms soils more readily than the hot rays of the sun.

The reason for the effect of color is explained by the fact that black absorbs heat rays and white reflects them.

8. Effect of a Dust Mulch.—Nearly fill two cans with garden soil of the same kind. Moisten them and pack them alike. This packing should be done by striking the cans on a table or the floor to draw the soil particles together. On the top of one spread a half-inch layer of loose, dry soil to form a "dust mulch." The top of the soil in the other can should be pressed with a smooth surface, as the bottom of a bottle, giving the effect of a field roller on a field surface. Now, with the scales used in a preceding exercise, weigh each of the cans of soil and record their weights. Allow them to stand either in the room or dry, open air for about two days. Weigh each again. Which has lost more moisture? If the experiment has been carefully done, and the soil has not cracked or shrunken away from the sides of the can, the loss will be greater from the "rolled" soil. The dust mulch checks loss of moisture.

In garden work, a dust mulch may be maintained among the plants between the rows by the use of a common garden rake or with small shovel cultivators. Moisture which is abundant in the soil in early spring will be held by the use of a dust mulch until it is needed by the plants during the dry weather of summer. The maintenance of a dust mulch throughout the growing season is best for most garden crops (Fig. 65).

9. Carpet or Hay Mulch.—In warm, dry weather, place a piece of carpet or a layer of hay a few inches thick over about one square yard of bare soil, leaving other bare soil near it for a comparison. After a few days of dry weather remove the carpet or hay mulch and notice the difference between the soil just uncovered and the rest.

A mulch of any kind on soil prevents much of the evaporation of moisture from it. This is because there is no continuous solid matter through which the moisture may climb by capillary action. It is by capillary action that oil climbs in the wick of a lamp, and it is by the same process that moisture climbs in the soils of the field. A mulch on top of dust or fine soil made with a harrow, or of other material, breaks the capillary contact of the particles and thus checks upward movement of moisture into the air.

10. Dust Mulch on Sugar.—Try an experiment as illustrated in figures 66 and 67. The liquid may be water colored with ink. Explain why the loaf sugar becomes wet so quickly and why the powdered sugar is very slow in taking up the moisture.

Figures 68 and 69 show soil packed with roller packer which leaves a loose mulch on top. Moisture is thus drawn up near the top, but is not allowed to escape into the air.

FIG. 65.—A footprint packs the soil but destroys the surface mulch. A rake will restore the mulch again. (Dunham Co., Berea, O.)

11. Baking of Sand and Clay.—Nearly fill two cans, one with a light sandy soil or pure sand, the other with heavy clay soil. Have them both as nearly the same in moisture as possible. Place them in a sunny window or sheltered sunny spot out of doors. After drying a few days compare them as to shrinkage from the sides of the cans. Does either show signs of cracking? The same experiment may be tried by placing the two soils in cigar boxes.

Heavy clay soils are much more apt to bake or become crusty and then form cracks or fissures (Fig. 64). Young people have noticed the large cracks found in hard roads during the dry summer weather. Such fissures allow soil to dry out more rapidly.

Sandy soils seldom form fissures because the particles are so loose they crumble and fall together.

Tilling the soil soon enough after each heavy, beating rain will prevent the formation of a crust and thus prevent cracking. Garden soil should be cultivated or raked frequently during dry weather to prevent the loss of moisture through fissures and crusty layers.

12. Packing of Sand and Clay.—Old newspapers may be used on which to mold samples of several kinds of soil. Heavy clay loam may be wet and molded into the form of large marbles, about one inch in diameter. In like manner, mold samples of light sandy loam. Place these in a cigar box and lay aside for several days to dry. Then compare them in hardness and ease of breaking.

Sandy soils crumble readily after being plowed and dried in the wind. Clay soils are likely to become cloddy if the lumps are not crumbled before they dry.

FIG. 66.

FIG. 67.

FIG. 66.—Liquid will rise rapidly in a lump of sugar, as it does in packed soil. (Dunham Co., Berea, Ohio.)
FIG. 67.—Liquid does not escape through the loose mulch on top. (Dunham Co., Berea, Ohio.)

All soils should be harrowed immediately after plowing, unless they are to remain exposed to the effects of freezing weather through the winter. If ground is plowed in the fall, it should be harrowed as early in the spring as possible. Soils left to dry after plowing will lose moisture rapidly unless harrowed promptly. If they be clay loams, the clods formed may remain unbroken for a number of years. This is very bad for any garden or field.

13. **Capillary Movement of Water.**—Tie cloths over the large ends of two lamp chimneys, and fill one chimney with a sandy loam and the other with a clay loam. The soils should be sifted and dried before using. After filling the chimneys, the soils should be packed alike. Place both in a dish of water with a splint, to allow the free entrance of water (Fig. 70). For an hour or so, watch the climb of the water by capillary movement in these two kinds of soil. Moisture rises quickly, but not so high, in coarse sandy soils. It will rise much higher in the finer clay soils.

FIG. 68.—The soil packer shown here leaves the surface slightly ridged but loose—an ideal seed bed for the garden. (Dunham Co., Berea, Ohio.)

The experiment explains why sandy soils suffer from drouth more than others. In dry weather, moisture may not rise enough in the sandy soils to supply the needs of plants.

FIG. 69.—The best forms of roller should leave the surface loose, as shown at the right, to check evaporation. Such a roller is a good clod-crusher and soil packer. (Dunham Co., Berea, Ohio.)

14. **Packed and Loose Soils.**—Use the same apparatus as in the preceding exercises, but fill both chimneys with the same kind of dry sifted soil. Pack one thoroughly, by shaking and jarring; then refill. Leave the other as loose as possible. Place in water, as shown. Note the rate of capillary rise of water. If the experiment is carefully tried, the rise of water will be much faster in the packed soil.

When garden soils are rolled, the soil is packed and the moisture from below is brought toward the surface rapidly. This is done when small seeds are planted, for the purpose of bringing moisture to them to cause germination. Unless a dust mulch is produced soon afterward, the water will escape and be lost in the air. When soils are rolled, the roller should be followed with a harrow or weeder to break up the very top layer of soil. Rollers with a rough surface are used by some farmers for the purpose of bringing moisture close to the top and then checking its evaporation.

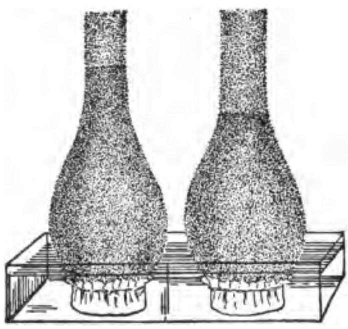


Fig. 70.—Fine-grained soil (clay) conducts water upward farther than sand.

15. Absorbing Power.—With several bottles and cups or glasses, arrange an apparatus as shown in figure 71. Use several kinds of soil. Perhaps only two or three different kinds will be available. Pour water over each soil, keeping it covered. Note the time required in each case for the water to begin dripping through below.

This shows which kind of soil will take in rainfall most rapidly. Those with close texture retard the flow of water, and much of the rainfall on such compact soils will run away during heavy rain.

16. Water-holding Power.—Arrange the apparatus as in the preceding exercise (Fig. 71). After the different dry soils are placed in the bottles, a definite amount of water is poured on each soil. Care is taken to carefully measure the water used on each soil. When some runs through below, no more is poured on that soil. After each is through draining, the water in the lower cups is poured back into the measuring cup. The amount of water each soil keeps is easily determined.

Some trials show that soils full of humus hold many times the amount of water held by sand. One trial showed that one pound of each soil, when saturated, held water as follows: Sand, 4 ounces; heavy clay, 8 ounces; black garden soil, 10 ounces; humus or marshy soil, 2 pounds. These figures illustrate the water-holding power of soils rich in humus.

17. To Analyze a Soil.—In a wide-mouthed bottle or glass jar place one inch of soil from the garden. Fill the vessel half full of water. Place the hand over the bottle and shake the contents vigorously for one minute. Then allow it to stand for an hour or more. Examination will show the soil to be in several layers be-

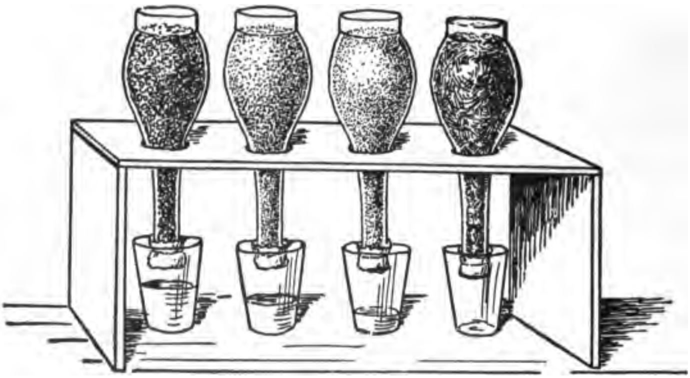


FIG. 71.—Soils of different types may be tested in their water-holding powers with such an outfit, by filling each chimney of soil with water until saturated. When the dripping stops the amounts of water retained by them may be compared.

neath the water. The heavy, coarse particles, as gravel and sand, are at the bottom. Those finer than sand are above, and are called silt. The finest are on top or are suspended in the water if it is yet muddy.

From this trial the student may form some definite idea as to the proportion of sand, silt and clay. If there is 30 per cent of the combined silt and clay, the soil is considered a very heavy one. If there is from 10 per cent to 20 per cent of silt and clay, the soil will be called a sandy loam.

When soils are washed by falling water during heavy rains, the sand is carried a less distance and is deposited first. The clay is carried much farther and gives the streams of water a very muddy appearance. The presence of organic matter in upland soils helps to prevent their washing.

A study of the streams of any section of the country will indicate to the student the character of the soils of that section. Muddy streams indicate clay soils with a poor supply of organic matter. Clear streams indicate either a sandy soil or a good supply of organic matter in the upland soil. The difference in streams, however, may be partly due to the amount of soil left loose by tillage.

CHAPTER XI

GARDEN PLOT EXPERIMENTS

MANY lessons in the school garden are best taught by means of experiments. Convincing results are shown when plots are treated in different ways, showing a marked contrast in results. Suggestions for a number of such experiments are here given. In each of the trials care should be taken to have the plots of the same size. The treated plot should be like the untreated plot in every particular, except in the one feature under trial.

1. **Spraying for Potato Beetles.**—Use a suitable mixture, given in another exercise as three pounds arsenate of lead to fifty gallons of Bordeaux mixture, or fifty gallons of water. The plots for this may be adjacent rows in the garden. Let one row be sprayed in the best manner possible, and the other left unsprayed. Note the effect on the crop and determine the profit gained by a farmer in spraying an acre of potatoes.

2. **Fighting Potato Blight.**—If Bordeaux mixture is used in the above trial, a comparison may be made in the matter of blight. Another experiment may be carried on with the poison omitted, or the poison may be applied on both rows and the Bordeaux mixture on only one of them. This would perhaps be the best trial. The yields should again be compared and the profit from spraying calculated.

3. **Deep and Shallow Culture.**—In a corn field or sweet corn garden make a comparison of deep and shallow tillage. It is proved by good farmers that shallow tillage is better than deep tillage in the cultivation of corn after the roots have extended well out from the plants. Let three or four rows be cultivated by very deep tillage throughout the season. A like number of rows may be cultivated with the shovels, or teeth, set very shallow. Carefully measure the yields from these

plots and report results. The difference in cost of work should be considered.

4. **Killing Weeds.**—Compare the "bare fallow" method of killing weeds before they are up with the method of plowing ground for corn or potatoes just before time to plant. In which plots are the weeds worse during the growing season?

5. **Variety tests** may be made of any kind of crop. Determine the difference in time required for growing crops of radishes of different varieties; or compare the yields of two varieties of potatoes grown in rows side by side. Variety tests of certain field crops may also be made in the garden. Thus the garden may be made a place for determining future field practices on farms in the neighborhood.

6. **Determine the proper depth** for planting beans, peas, corn or other large seeds by planting parts of a row at different depths.

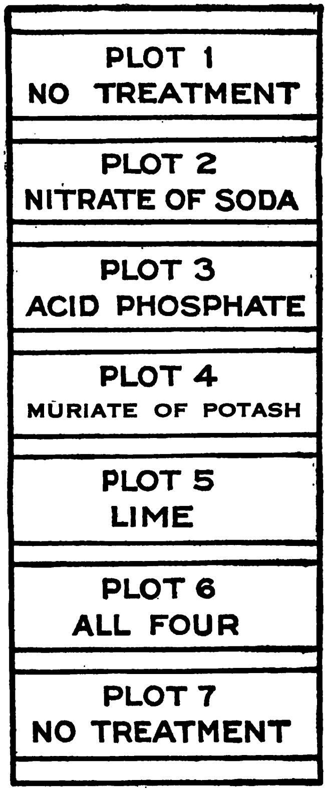


FIG. 72.—A suggestive plan for plots in testing fertilizers with any crop desired.

7. **Level or Hill Culture.**—Try early potatoes by the level culture method and the hilling-up method. Late potatoes may be compared in like manner. Some believe in hilling-up early potatoes, and use level culture for late potatoes. These experiments will answer such disputed questions.

8. Heavy Fertilizing.—Try the effects of more fertilizer than usual, keeping account of the added cost. Consider this in connection with the yield and determine whether heavy applications are profitable (Figs. 72 and 73).

9. Lime for Potatoes.—It is generally believed that lime

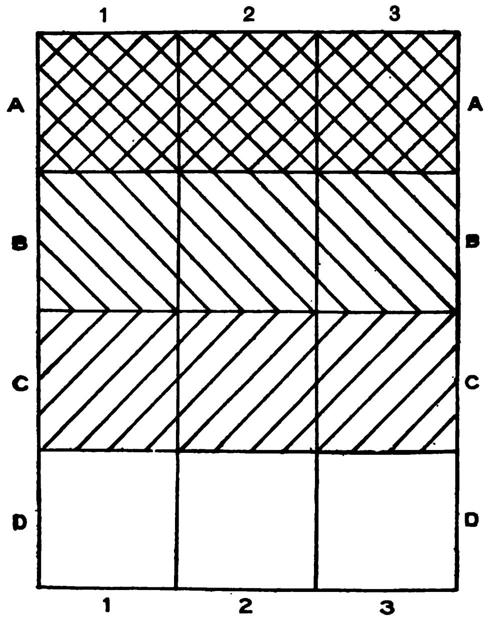


FIG. 73.—A scheme for experimental plots with trials of four east and west and three north and south. Suppose the experiment is with alfalfa 1–1, red clover 2–2, and crimson clover 3–3, Across these plots let the cross strip *A-A* be both limed and inoculated properly for each kind; let *B-B* have lime only; let *C-C* have inoculation only; let *D-D* have neither lime nor inoculation. Otherwise the plots will be treated alike.

is harmful to potatoes by making them more scabby if the disease is present in the seed or the soil. Let one row be limed and another not limed.

10. Effect of Treatment for Potato Scab.—In connection with the preceding trial let another be made testing the value of treating seed potatoes with formalin before planting (see directions in Chapter XX). Let two rows be treated and two rows be untreated. The liming mentioned in number nine may be the one row of each of these pairs.

11. **Effects of Dust Mulch.**—Compare two rows of corn or potatoes with and without the dust-mulch method of culture.

12. **Firming the Soil.**—At planting time let the seeds in one row of the garden be pressed firmly against the soil by tramping on the row after planting. Let the adjacent row be planted in loose soil without firming.

FIG. 74.—Each tomato plant may be reduced to a single main stem and tied to a single stake for support. Some pruning of the "suckers" and side branches will increase the rapidity of ripening. (U. S. D. A.)

13. **Testing the Treatment for Codling-Moth.**—Spray one apple tree of a certain variety for codling-moth and apple scab, using Bordeaux mixture and Paris green at the time the petals fall. Let another tree remain unsprayed and compare the results by counting or measuring the number of sound or unsound apples on the trees when ripe. Calculate the cost of spraying and determine the relative value of the crops. This trial may be made by one or more young people in their home orchards.

14. **Oat Smut.**—Treat a pint of seed oats by soaking in a solution of formalin, as described in another exercise. Plant the treated oats in one row of the garden and a like quantity of untreated seed in a parallel row. Compare the results

when the crop is mature, and determine whether the treatment is profitable.

15. Staking Tomatoes.—Stake one row of tomato plants and tie the plants up well. Let the plants of the next row grow without staking. Determine which ripen first, which rot worse, and which are harder to pick. If possible, calculate the cost of staking and tying. Compare the extra cost with the increased returns from the crop (Fig. 74).

FIG. 75.—Vetch plots, with inoculation on right, no inoculation on left. (Fights of the Farmer.)

16. Thick or Thin Plantings.—Plant one section of a row very thick, say with lettuce or beets, then another part may be planted rather too thinly, and another part of medium thickness. Study the effects of crowding in the first section; note the extra growth of weeds where the plants are too thin.

The trial may be varied by planting all the row alike and then thinning the plants after they are up, to study the benefits of thinning.

17. Watering vs. Surface Mulch.—Two halves of a row may be treated to show benefits of mulches. Water one half often and the other half less frequently, but, with a rake, keep a surface mulch of fine soil on the last half.

18. Straw Mulch.—Some crops, such as late potatoes, are benefited by a mulch of straw, leaves, stalks, or other litter between the plants. This may be tried in hot weather. Mulch one plot and leave the other bare. Try the experiment with tomatoes, beets, lettuce and other crops.

19. Inoculation of Legumes.—A good home project is to grow vetch, alfalfa, soybeans, or other legumes with and without inoculation, as suggested in figure 75.

CHAPTER XII

BEAUTIFYING HOME AND SCHOOL GROUNDS

It is a well-known and frequently observed fact that rural and village homes and rural and village schools are devoid of exterior decoration. Liberal use of trees and shrubs and a little attention to the lawns would make the present unsightly places much more attractive. Farm homes sometimes depreciate in value and are offered for sale below the value of the buildings because of the unsightly premises. Houses, barns, and other buildings have not been painted. Fences are in bad condition.

A small investment in the form of money and labor in trees and shrubs with which to plant the grounds will greatly enhance the value of many a farm home. If the place is not for sale, this is no reason for delaying such planting (compare Figs. 76 and 77). No one ever knows how soon a place may be thrown upon the market.

Aside from the question of market value of a place, all homes and schools should be decorated for the training which it will give to young people. A place of beauty is a joy to the young folks during the years which they spend at school and home.

If the grounds about the school are kept neat and are attractive to the eye there will be much less damage done to the school property by persons of malicious disposition. The moral training to be gained from the proper maintenance of buildings and grounds is as important as the moral training gained from the choice of a good teacher.

Where conditions are bad the influence of a good teacher may be entirely overcome. Filthy out-buildings and obscene caricatures and words are more than enough to overcome all good influences. Young people constantly surrounded by such bad environment have a hard struggle in later life to overcome the early evil training. Many fail to overcome this and it is a lifelong handicap to them.

FIG. 76.—A house without vines, shrubs, or trees looks bleak and cheerless. (U. S. D. A.)

FIG. 77.—A place may be transformed by proper use of paint and planting. (U. S. D. A.)

Planning the Grounds.—Pamphlets on this subject are issued by extension departments of agricultural colleges. All experiment stations give suggestions for the planning and planting of school and home grounds. U. S. Farmers' Bulletins 185 and 248 will be very helpful. Students in geography may be assigned the work of making a map of the grounds as they now exist, showing the location of the lawns, walks, buildings, permanent trees and any other permanent marks. It is good practice to learn to draw to a definite scale—say one quarter inch to the foot. Older persons may give suggestions as to the future development and planting, but the main suggestions may be secured from pamphlets on

FIG. 78.—A prize back yard and the family who enjoyed it. (Photo from Children's Flower Mission, Cleveland.)

ornamental gardening. The school grounds on any plan should allow for a school garden plot including vegetables, flowers and fruits. The play-ground should be carefully planned. The ornamental planting is to fit in with the other plans and embellish them.

Out-buildings should be hidden by the use of vines and tall shrubs (Fig. 78). The grounds of the main building should be surrounded by clumps of shrubs. These may be low enough to never reach the windows. Clumps may surround the entrance on each side of the walk. Shrubs may be massed in groups at the angles or curves of walks and driveways. Borders somewhat irregular in width may be planted along outside lines or between the play-grounds and the garden. Shrubs should seldom, if ever, be planted in rows or scattered at random over the lawn. Large trees may be planted in rows along roads, fences or street lines.

Wide areas of lawn, free from trees or shrubs, form a beautiful greensward. This should cover most of the area. The well may be nearly surrounded with beautiful clumps at a suitable distance from it.

Let all the planting assume grace and natural curvature of outline. Formal gardening is not so desirable. Pruning evergreens in grotesque and artificial forms is not natural nor ornamental. Such was the fashion many years ago. The branches of evergreens and shrubs should be left near the ground to form a pleasing effect of blending the foliage with the surrounding lawn. Vines may be used on trellises over the porches and in the angles of buildings, thus giving a softening beauty to rugged structures.

In the plans made by young people shrubs may be indicated by curved lines or shading, vines by a different kind of lining, and trees perhaps by the use of colored pencils. By the side of the plans should be written the names of such trees, shrubs and vines as are to be used in the plan. The exact location for each may be indicated by the use of numbers on the map and opposite each plant.

What to Plant.—Native trees, shrubs and vines should be selected if possible. Do not plant untried varieties. If native plants cannot be secured in suitable form for transplanting, material from nurseries may be chosen. In such cases use plants which are well known and have succeeded in similar soil in the vicinity.

Trees.—In selecting trees from the woods choose those which are growing in open places and have bushy, well-balanced tops. Those growing near together are slender and will not look well when planted in the open. Plenty of room for digging the roots must also be considered. It is usually best not to transplant trees which have deep root systems with central tap-roots. Such are the nut and tulip trees. Among shallow-rooted trees may be mentioned most evergreens, maples, oaks, elms, basswood and ash. These will all be suitable for planting if specimens are selected of suitable form. A few mulberries, chokecherries and other native fruits may be planted to attract song birds.

Shrubs may also be selected from the native woods in many parts of the country, but there is more excuse for the purchase of nursery shrubs for the reason that beautiful flowering shrubs of the country have nearly all been propagated in nurseries. However, if these same shrubs are found native in the locality they should be used. The height to which various shrubs grow will help to decide where to plant them. Some are more graceful than others and are suited to more open places, such as the front borders or curves in driveways. Others are coarse, angular and rugged and may form the background for smaller and more graceful ones in front. The season of flowering for the different ones should not be overlooked. The most popular shrubs are those which flower in early spring. The planting of beautiful flowering roses is sometimes avoided for the reason that much temptation is offered to pick flowers and thus destroy the shrubs.

Shrubs which bear late fall or winter berries are attractive to song birds. This feature is well worth consideration.

Vines are frequently found growing wild in the region. Virginia creeper, Virginia clematis and grapes are very common native vines. Boston ivy, English ivy, Japanese clematis and other perennial vines are not expensive if purchased from nurseries. Annual vines should also be abundantly used. They give quick returns and lend encouragement to the work.

1. **How Vines Climb.**—In a window box or can, plant seeds of such twining plants as hops, morning-glory, beans and peas. Hops may be started from cuttings. After the plants are large enough, have some stakes ready for them to climb on. Note the method of climbing. The tip of hops will go around the stake in a different direction from morning-glory. What special plan for climbing is provided by pea vines?

The growing tip of hops goes around the pole or stake in the same direction as the hands of a watch lying flat in your hand. Other twining plants move in the opposite direction. An experiment may be tried of wrapping the vine contrary to its natural tendency and watching the results.

The young gardener in twining plants around stakes set for that purpose may make the mistake of starting them in the wrong direction. They will naturally unwind and perhaps fall to the ground. The work must then be done over again until the lesson is learned.

When to Plant.—Do not wait for arbor day. There is no objection of course to doing much planting on arbor day, but the planting will take several days perhaps. It may be done on any suitable days in early spring.

Transplanting.—The roots of plants must not be allowed to dry out. If trees and shrubs are transplanted from the neighborhood, the roots should be protected by wrapping with burlap, old carpets or other material. One good plan is to make a puddle of thick mud and dip the roots in that when first dug. Take them as promptly as possible to the grounds. Make a trench about the roots of these and cover with dirt until the permanent planting places are ready. Evergreens need to be handled with the greatest care. The soil should not be removed from the roots at all while being transplanted. They may be set into small boxes while being carried or the soil may be kept on the roots by wrapping well.

Trees received from a distance by hauling or shipping must be placed in a trench, as mentioned. This is called "heeling in." Roots exposed for some time to the action of air will suffer greatly and may never thrive. Large trees and evergreens must be planted with great care. Holes should be larger and deeper than the trees seem to require. Prune all broken and bruised roots. Place loose rich soil in the bottom to come in contact with the roots. The tree should be a little deeper in the ground than it was before. Fill the hole with the best soil and tramp it in well, but leave a little of the loose soil on the very surface. All trees and shrubs, except perhaps evergreens, should be pruned somewhat on the top to balance

Fig. 79.—A lesson in school-room transplanting may be the basis for lessons in language, arithemtic, spelling, drawing and penmanship.

the reduced root surface. If the weather be dry at the time of planting, water should be used, but care should be taken not to puddle the soil too much. A mulch should be left on top by the use of a rake to prevent loss of water by evaporation.

2. **Transplanting.**—Students should practice transplanting of many kinds of plants to obtain skill and avoid loss during the process. Slips and cuttings should be transplanted into pots and cans in the school room (Fig. 79).

During the transplanting process, roots should be protected from the air and sun. Keep them moist. If soil can be left attached to all roots so much the better. In the new location, the soil should be pressed firmly about the plant to cause a supply of moisture to reach the roots. Watering at transplanting time is always advisable because it washes the soil particles together and also supplies needed moisture. Removal of a few leaves, if the plants be green ones, is sometimes necessary. This is to prevent evaporation taking place more rapidly than the roots can take up water.

3. **Heeling-In.**—Students should practice heeling-in shrubs or young fruit trees to prevent injury to them while waiting to be planted in permanent locations. Dig a deep trench with one side sloping, laying the trees or shrubs down on the sloping side of the trench and covering the roots with an abundance of loose soil.

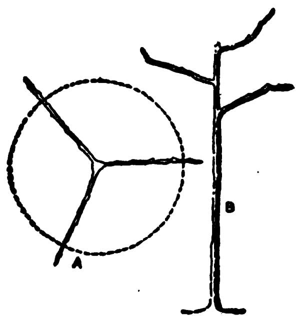


FIG. 80.—When a peach, apple or other fruit tree is first set out it should be pruned to three or four limbs which are the future main branches. They must extend in different directions and be located at different heights.

Heeling-in is a rapid process and may be practiced with plants brought from a distance while the planting process is going on, or until it is done. Large numbers of plants or bundles of plants may be put in a trench together and covered at once. Nothing is better than soil to maintain the life of plants waiting to be permanently planted.

4. **Pruning Young Trees.**—Bring to the school a number of young trees or branches of trees from the woods, which may correspond to young trees. Let students select the branches which they think should be saved to form the future head of the young trees. Study "a" and "b" (Fig. 80). Figures 81 and 82 represent trees headed low at pruning time. If roots be on the trees you have, suggest the pruning of the extra long roots or any broken or split parts.

The low heading of trees (Figs. 81 and 82) makes the future pruning, spraying, and picking all the more easily done than if the heading is too high.

Each year a part of the new growth is cut back to induce the formation of fruit buds and fruit spurs lower down on the branches. The strength of the crop is then also better.

FIG. 81.—A two-year-old peach tree will be ready to bear some fruit next year. Young people take great delight in the growth of trees they have planted.

Whenever branches become too thick or rub together, they should be pruned. Thinning the branches makes the fruit larger and lets in sunlight.

5. Care in Pruning.—Collect samples of good and bad pruning which will illustrate the importance of care in pruning (Fig. 83). Cut surfaces should be left as smooth as possible. If a saw is ever

FIG. 82.—This two-year-old apple tree of the McIntosh variety will begin bearing fruit in three or four more years. Note how low the bottom branches are —called a low-headed tree.

used for large branches the wound should be smoothed with a knife. Cut side limbs as close to the main stems as possible. Never leave stubs. Paint or grafting wax should be used over all large cuts to prevent weathering. Avoid cutting a large branch if the pruning of several small ones may be used to accomplish the same purpose.

Young gardeners feel much diffidence in the matter of pruning. They may learn many of the principles by bringing samples to the school and discussing them. If possible, a person with much experience in pruning should illustrate to the class the methods in vogue for different kinds of plants.

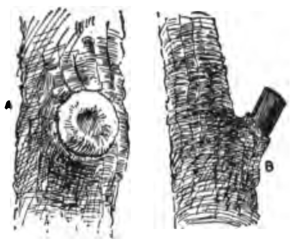


FIG. 83.—*A*, pruned close so that the bark can heal the wounds. *B*, not pruned close enough: the wound can never heal, but decay will follow.

6. Knowing the Trees.—Before time for planting trees and shrubs in the home and school grounds added interest in the trees may be gained by making collections of twigs of all kinds found in the neighborhood. Compare the twigs of pines, spruces, cedars or other evergreens. Twigs of deciduous trees should also be included. Each of these may be fastened by means of thread to large cards suitable for hanging on the wall. The name of each is placed by it. If any are found which cannot be named, send a sample to a state experiment station or to a teacher of botany in the nearest high school.

LAWNS

Some care must be exercised in the choice of grasses for the seeding of lawns. In the humid regions Kentucky blue grass is most successful (Fig. 84). It may have mixed with it some trailing white clover. In the extreme southern states Bermuda grass is extensively used in place of Kentucky blue grass. For dry regions smooth Brome grass may be abundantly mixed with the others. This grass has a coarse leaf, but is one of the best to withstand dry weather.

Suitable times for seeding are early fall and early spring. Grasses thrive best in wet weather, and before the root systems are well established they will suffer much from drought. For this reason summer planting is usually not successful.

Nurse crops are sometimes used in the starting of grass on lawns. For this purpose annual grains, such as oats in the spring or rye in the fall, may be used. The purpose of the nurse crop is to shade and protect the young grass plants while starting. Only a little grain should be used and this should be mowed before becoming tall to prevent the stealing of

FIG. 84.—A farm home with a beautiful side yard with greensward and mixed border. The family can be as justly proud of this as a city family.

moisture and nourishment from the grass. In some seasons several cuttings of the nurse crop will be necessary before it is killed.

Care of Lawns.—A number of points must be carefully attended to if lawns are to be kept in the best possible condition.

1. The soil should be made in fine condition before seeding. Plenty of fertilizer should be used at that time, unless the ground is very rich. The addition of fertilizers from time to time will help the lawn. Nitrogenous fertilizers, such as nitrate of soda, will give best results.

2. When the lawn is first sown plenty of seed must be used. A dense stand is always more beautiful. As the lawn becomes older, any places where the grass is thin should be re-seeded and the seed raked in or rich soil sprinkled over it.

3. Nearly all lawns require an application of lime every few years. This is true whether the soil be heavy or light. If plenty of lime was used at first, then two years later a second liming should take place. This may be done at almost any time of the year, but wet weather is more favorable than dry.

4. In early winter, when the ground begins to freeze, a top dressing of rich but well-rotted stable manure, free from weed seeds, should be spread on the lawn. The manure protects the crowns of grass from winter killing and the plant-food from the manure is well washed into the soil during the winter and early spring. As warm spring weather approaches, the lawn may be raked and a vigorous dark green growth of grass will follow.

5. All lawns should be cut a number of times each season. It is very detrimental to grass for it to become tall and form blossoms or seeds. Lawn grasses should spread by the growth of underground stems or similar vegetable parts. Never expect them to spread by the formation of seed. Frequent cutting has another advantage in the killing of many kinds of weeds. Frequent cutting is detrimental to weeds and beneficial to grass.

6. In the early part of each season lawns should be rolled to overcome the bad effects of any heaving by the action of winter frost. If lawn-mowers with rollers are used this will accomplish the purpose. Otherwise a special roller may be used once or twice during the spring. Another purpose of rolling is to cause the root stalks or runners to become well rooted, pressing them firmly against the soil, causing them to take root and the sod is made much denser.

Flower Planting.—The use of flowers in beautifying both home and school grounds is well understood by most persons. Young people should early learn the cultural methods and best uses of flowers (Fig. 85). Those varieties should be chosen for use which will produce a show of blossoms at seasons when most desired. If the school grounds are cared for during summer vacation, flowers may be kept growing throughout the season and varieties for fall blossoming will be valuable.

FIG. 85.—First prize front yard and the girl who beautified it. The greensward is left clean and the plantings are massed as borders. (Photo from Children's Flower Mission, Cleveland.)

Annual flowers are those which give their show of blossoms the same year in which the seeds are sown. They usually die after the blooming season is over. The seeds in most cases are sown in the garden, but a few of them may be planted in window boxes, and later transplanted to the garden. This will make them blossom much earlier. A few of the hardy annuals may be sown in the autumn and transplanted to boxes and then stored in coldframes through the winter. By this plan blossoms can be obtained next spring perhaps before school is closed. In the warmer parts of the country the hardy annuals, such as sweet peas, are planted in the fall in the open ground and left there during winter. If they sprout before freezing weather, a little protection may be needed in the form of leaves or similar mulch.

The terms annual and perennial are rather indefinite, as the climate changes the character of many plants. Plants which are tender annuals in the north may be considered hardy or live for several years in the extreme southern states.

Hardy Annuals.—In the middle states the following plants are considered hardy annuals: Ageratum, aster, calendula, calliopsis, California poppy, candytuft, larkspur, gilia, morning-glory, marigold, mignonette, phlox, pinks, portulaca, sweet alyssum, sweet pea, stocks and zinnia.

Tender Annuals.—Examples of annuals which are rather tender in the middle states are balloon vine, balsam, cosmos, cockscomb, cobea, caladium (bulb), castor beans, dahlia gourds, martynia, nasturtium, petunia, sensitive-plant, and verbena.

Planting Annuals.—Very few of the annuals thrive in shady places. Most of them prefer sunny exposures (Fig. 86). They prefer good garden soil and most of them will be better when a liberal amount of well-rotted stable manure is added. The soil should be prepared by deep spading or plowing. It should be raked well and firmed down by tramping or by the use of a board on which the planter stands while he is planting. Most annual flower seeds should be planted shallow and pressed firmly to cause them to sprout promptly. They may be planted along the borders of lawns (Fig. 86) or any special beds where they will add to the beauty of the general planting scheme. Care should be exercised to prevent grass roots and tree roots from robbing the moisture and fertility from flower beds. The use of a spade around the margins to cut off such roots is recommended. When flower beds are planted tall varieties are planted near the center or distant side, with lower varieties around or in front of them. Very low ferns may serve as border plants. U. S. Farmers' Bulletin 195 will help in the choice of annual flowers for special places. Fall annuals may be used as screens where quick effects are desired (Fig. 86).

Perennial Flowers.—There are large numbers of perennial herbs which die to the ground each year and come up from the root again each spring, producing a show of flowers or beautiful foliage each season. These are easily grown from

FIG. 86.—While waiting for permanent shrubs and vines to grow, the void may be filled by annual plants. The purple-leaved castor beans shown here grow rapidly.

seed, and will usually produce flowers in a year or two. They will give quicker results if started by roots. The seed is usually sown in the open ground, but some varieties, such as pansies may be started in hotbeds or window boxes. The soil should be mellow and fine and rich in organic matter. When the seeds are planted the surface should be firmly packed and perhaps additional water may be necessary. Partial shade, as from boughs spread over the ground to protect the young seedlings, is usually best. Most varieties may be transplanted after the plants are a few inches high. Two seasons are suitable for this work. Early spring is usually preferable, but late summer is also used.

Early Perennials.—Among the early flowering hardy perennials are the following. These are arranged somewhat in order of flowering season:

Wind-flower, bloodroot, rock-cress, spring beauty, hepatica (liver-leaf), wake robins, blue-bells, shooting star, candytuft, forget-me-not, peony, phlox, columbine lily-of-the-valley, bleeding-hearts, iris.

Summer Perennials.—Common summer flowering plants of the perennial group are: Pennsylvania anemone, St. Bruno's lily, blue columbine, mallow, harebell, Canterbury bell, Scotch pink (dianthus), Japan iris, blazing star, oriental poppy, paniculata phlox, yucca, hollyhock, chamomile, delphinium, funkia, helianthus, pentstemon, day lily, flame flower, cardinal flower, chrysanthemum, golden glow, goldenrod.

Autumn Perennials.—A few of the preceding group continue their flowering well into the autumn. Other late flowering ones are Japanese wind-flower, hardy chrysanthemums, Jerusalem artichoke.

Bulbs and Tubers.—The culture of bulbs and tubers is not difficult. Many bulbs are planted in the fall and blossom in the early spring. Common examples of these are crocus, tulip, hyacinth, narcissus, squill and snowdrop. The planting is done late enough in the fall to avoid growth above ground before winter. They keep well in the ground and are ready to start in very early spring. The large store of nourishment which they have forces the growth rapidly as the soil becomes warm enough. The bed should be mulched for two reasons, (*a*) to prevent them from starting in warm weather in fall or mild winter days; (*b*) to protect the ground from heaving during the coldest weather.

Autumn Flowering Bulbs.—Several species of crocus bloom in the autumn. Japanese lilies and others begin blossoming in summer and may continue until autumn. Colchicums are fall blooming bulbs, excellent for general planting. Any bulbs of this group may be placed in the ground in either early or late summer.

Culture of Bulbs.—Soil for bulbs should be deep, rich and well drained. When bulbs are placed in undrained soil they are apt to rot instead of producing vigorous growth. Any manure added should be well rotted to prevent heating. A number of varieties of bulbs may be left in the ground for several years and continue to bloom at their natural season each year. This is true of lilies, crocuses, colchicums,

FIG. 87.—Cannas may be massed in large beds in the side yard.

narcissus and others. Tulips and hyacinths should be taken up each summer and re-planted in autumn. This is done after the foliage dies down naturally. The bulbs are then dug up and stored in a dry place until the next planting time. (See forcing of bulbs, Chapter XV.)

Cannas (Fig. 87) and *caladiums* are very showy bedding plants, with tuberous roots. The roots may be dug before the ground freezes and stored in the cellar. They are often started in pots or boxes early in the spring. Transplanting to the open is not done until all danger of frost is over. In the South the roots are sometimes left in the ground all winter and protected with a mulch of leaves or other litter.

Plants for Shaded Places.—There are few gardens and grounds that do not have shaded positions, where it is difficult to get plants to grow. Such spots often spoil the otherwise fine appearance of the grounds. These are difficult of treatment, and suitable plants must be selected for the places. The trouble is often due to the lack of moisture or plant-food, as well as lack of sufficient sunlight. This is shown by the absence of vegetation found under trees in the dense woods. Where moisture and plant-food are abundant, shade is not such a great obstacle.

If the shade is caused by large trees, their roots dry out and impoverish the soil and the branches keep off much of the rainfall. If the ground becomes mossy it is a sign of sourness, and lime or wood ashes is needed. The ground should be spaded deep to cause the tree roots to grow deeper. Water may be resorted to, but deep spading and thorough fertilization are more important.

Plants well suited to shady spots are ferns, wood anemones, rhododendron, mountain laurel and a host of flowers found in woodlands. A liberal mulch of rotted stable manure is an excellent thing in both winter and summer.

ARBOR DAY

As the spring season of planting approaches and all Nature is preparing to show her most beautiful dress, students should become interested in ways of beautifying the school. There is not a school in the land that cannot be made more beautiful, and many of them may be improved very much. The pupils will take a great interest in the matter if they receive a little encouragement and leadership on the part of their teachers.

Beautify the school grounds. A woven wire trellis supporting a thrifty vine would be a beautiful screen for those unsightly outbuildings. Shrubs about the base of the school building, in the angles of walks and growing in natural clumps in the corners of the grounds would add beauty and pleasure to the school surroundings. A few plots not used for play or for garden may be grassed. Never scatter the trees or shrubs openly about the lawn area. Better mass the shrubs in natural clumps in angles or along foundations, walks and borders. Use the trees along boundary lines, and division lines. Native trees and shrubs are always preferable to the imported or exotic kinds.

Planning for Arbor Day should begin early and should include a number of lines of preparatory work.

Send for a number of farmers' bulletins, first.

Draw plans of the grounds, measuring the lines and distances to make it somewhat accurate. If a class is assigned to this task the best map may be framed for the future use of the school. A passe-partout binding, at least, may be used. This map may show the plan of planting for several years, if there is more to be planted than the school can do this year. The walks, buildings, clumps of shrubs, trees, school garden, and play grounds should all be shown. If there is time, send a sketch of this to the Department of Education at the State Capital or to the State Agricultural College for criticism or approval.

This work may be done by an arithmetic class or a geography class. The arithmetic class may also find suitable dimensions of the corn contest plots.

Have the reading classes begin now to read about birds, gardening, trees, lawns, and weeds. Use the newer words in spelling exercises. Let boys and girls both make bird houses at home. These may be ready to put up on Arbor Day.

The corn testing and seed study should begin right away.

Trees, shrubs and seeds that are to be planted on Arbor Day or soon after should be ready in advance. The roots of trees and shrubs must be covered with soil to prevent drying out.

Some exercises in root grafting of apples may be carried out as described in two of the U. S. Farmers' Bulletins, 113 and 408.

Tools to be used in the planting of school grounds may be brought by pupils from their homes; the list available for the purpose should be made in advance.

Divide the students into suitable groups for the work so that each will know his part to carry out.

Invite parents and home folks to the work of Arbor Day, and make it a community exercise. The men may come in the morning to work and the women come with lunch baskets at noon, and stay until the exercises of the afternoon are over.

Plan to have some one take some pictures of the children and patrons that day while the improvement work is going on.

Do not forget to have some manure and good soil hauled, in advance, for use in the planting.

SUGGESTIVE PROGRAMS

(*To give at 3 o'clock, after the day's work is done*)

1. Remarks by the teacher or a member of the school board on the value of teaching the useful and beautiful as much as the classical and historical.

2. Let five pupils stand together. The first pupil will read from a bulletin or tell in his own words why we should all know more about trees; the second the same about insects; the third about weeds; the fourth about birds; and the fifth about corn.

3. Let five girls stand and each tell a few things about some useful bird mentioned in U. S. Farmers' Bulletin 513.

4. Let a boy that has made a bird box tell how bird boxes are a protection to young birds, and how he made that one.

5. Let a boy tell of some ways of destroying English sparrows learned from U. S. Farmers' Bulletin 383.

6. Another boy should tell how to know English sparrows from other sparrows and common birds.

7. Let some of the best tree planters tell how to plant a tree—preparation of soil, roots, pruning and actual planting.

NOTE.—In any or all of these exercises pupils may get the subject-matter from this book and from bulletins referred to in it. They may make note on paper of what they wish to say and speak from these notes. If the time for preparation be very short, the points may be copied and read directly. Let each exercise be very short.

ANOTHER PROGRAM

(*Suggested for the last part of Arbor Day, afternoon or evening*)

1. Announcement of outlines of contests in school or home gardening, corn growing, or other work the school may be planning to take up, and the premiums offered or expected for the contests and exhibits next fall.

2. Debate (two pupils on each side): Are crows more harmful than beneficial to man? (In place of crows may be substituted blackbirds, or hawks, or English sparrows.)

3. Some pupil may tell of several benefits of trees and forests, or five pupils may stand together and each tell of one important benefit.

4. Let a pupil describe how to test seed corn by the individual ear method.

5. Have two pupils tell of the two types of insect mouths, each telling how to control such insects.

6. Let a boy tell of three or four things necessary to improve the home lawn. (See U. S. Bulletin 248.)

7. Let three pupils stand and each take one part:

(*a*) Use of vines to beautify the grounds at school or home, and name some vines to use in certain places.

(*b*) Use of trees in same way.

(*c*) Use of shrubs in same way.

The Planting of Flowers. Dates are for Latitude of New York. (Cornell Reading-course Leaflet)

Name of flower	Amount of seed for 10 ft. of row	Time to plant: Hotbed	Time to plant: Open ground	Distance apart (inches): Between rows	Distance apart (inches): Between plants in row	Depth to plant seed (inches)	Hardy, half-hardy, or tender	Height to which plants grow (feet)	Annual—A Biennial—B Perennial—P	Season of blooming
Ageratum	1 pkg.	March	May	12	6	¼ to ½	Hardy	½ to ¾	A	June to frost
Alyssum	1 pkg.	....	May	12	6	¼ to ½	Hardy	¼ to ½	A	June to frost
Antirrhinum	1 pkg.	March	May	12	12	¼ to ½	Hardy	1 to 3	P	July to frost
Aster	1 pkg.	March	May	12	9 to 12	½ to ¾	Hardy	1 to 3	A, P	July to Oct.
Balsam	1 pkg.	April	May	24	24	½ to ¾	Tender	2 to 2½	A	July to frost
Calendula	1 pkg.	April	May	12	6	¼ to ½	Hardy	⅔ to 1	A	June to Oct.
Campanula	1 pkg.	March	April or May	12 to 18	12	¼ to ½	Hardy	2 to 3	A, P	June to Aug.
Candytuft	1 pkg.	April	May	12	4 to 6	¼ to ½	Half-hardy	½ to [illegible]	A	June to Oct.
Centaurea	1 pkg.	April	May	18	6	¼ to ½	Hardy	2 to 3	A	June to frost
Chrysanthemum	1 pkg.	March	May	12 to 18	8	½	Hardy	1 to 4	A	June to Oct.
Cockscomb, low	1 pkg.	April	May	18	12	¼ to ½	Hardy	1 to 1½	A	June to frost
Cockscomb, tall	1 pkg.	April	May	24	24	¼ to ½	Hardy	3	A	June to frost
Convolvulus (morning-glory)	1 pkg.	....	April	To climb on some support	6	½ to ¾	Hardy	10 to 15	A	June to frost
Coreopsis	1 pkg.	March	April	18	10	½	Hardy	1½ to 2	A, P	June to frost
Cosmos	1 pkg.	April	May	24 to 30	24	½	Hardy	4 to 8	A	July on*
Dahlia	1 pkg.	March	May	12 to 18	6	½	Half-hardy	4	P	Aug. to frost
Dianthus	1 pkg.	March	May 1–10	12 to 18	6	¼ to ½	Half-hardy to hardy	1 to 1¼	A, P	July to frost
Hollyhock	1 pkg.	March	July to Sept.	24 to 36	15	½	Hardy	5 to 7	P	Aug. on
Larkspur	1 pkg.	March	May	12	12	¼ to ½	Hardy	1 to 5	A, P	June to Sept.
Marigold	1 pkg.	April	May	12	6	¼ to ½	Tender to half-hardy	½ to 2	A	July to frost
Mignonette	1 pkg.	March	May	12	12	¼ to ½	Tender to half-hardy	1 to 1½	A	July to frost
Nasturtium	1 pkg.	April	May	12	12	½ to ¾	Half-hardy	¾ to 1	A	June to frost
Pansy	1 pkg.	March	April	12	6	¼ to ½	Hardy	⅓	A	April to frost
Petunia	1 pkg.	Feb. or Mar.	May	12	12	¼	Hardy	1	A	June to frost
Phlox (annual)	1 pkg.	March	May	18	12	¼ to ½	Hardy	1	A	June to frost
Poppy	1 pkg.	....	Ap., Sep., Oct.	12	12	¼	Hardy	1 to 2	A, P	June to Aug.
Salvia	1 pkg.	March	May	24	18	¼ to ½	Half-hardy—P to hardy—A	2 to 3	A, P	Aug. to frost
Stock	1 pkg.	March	May	18	12	¼ to ½	Hardy	1 to 1½	A, B	July to Sept.
Sunflower	1 pkg.	April	May	36 to 60	24 or more	1	Hardy	6 to 10	A	Aug. to frost
Sweet peas	2 pkgs.	....	April	36 to 48	Thick	1 to 1½	Very hardy	2 to 6	A	July to Sept.
Sweet William	1 pkg.	March	June	12	6	¼ to ½	Hardy	1½ to 2	A, P	June, July

* Early, July to August. Late, September to October.

CHAPTER XIII

LESSONS WITH TREES

IT is often a good plan to plant chiefly those trees and shrubs that are indigenous to the climate and soil of the section. Native trees and shrubs cannot always be obtained from nurseries. It is therefore desirable to select good specimens in the open places in native woods, along streams, and elsewhere. The most serious objection to this method is the difficulty in securing enough of the good fibrous roots. This may be done by cutting the main roots of the tree at a suitable distance from the trunk one year before the tree is to be transplanted. During this interval there will be an abundant growth of fine roots near the places where the main roots were cut. Nurserymen use this method for their larger shade trees.

The tops of the trees may also be pruned the year before we do the transplanting. This previous work will make many of the trees much more shapely and more suitable for ornamental planting.

EXERCISES

The following lessons with trees are given in exercise form for the purpose of making them more concrete. The full discussions are for the benefit of any who are unable to perform the exercises.

1. Sap Ducts in Plants.—Select some cuttings of leafy branches of such trees as willow or poplar or green cuttings from any woody plants. Place these in some water well colored with red ink. After a day, cut across a few of the stems a few inches above the water. Split other stems and examine each for the colored ducts which carry the sap up the stem. In which part of the stem are these ducts located? Has the sap traveled upward in the bark, sapwood or heartwood?

The purpose of coloring the liquid is to show plainly where the ascending sap travels. The value of the exercise is better understood in connection with the next exercise.

2. Effect of Girdling Trees.—Select a tree of any kind which is to be cut down. During spring growth, remove a strip of bark two or three inches wide clear around the trunk or main stem of the tree. Leave the wood entirely exposed with no covering of bark. After a few days or weeks, note the effect on the tree. When does the death or injury first begin to show?

Mice and rabbits frequently injure the trunks of trees in the orchard. They are very fond of gnawing the bark of apple trees during winter. In connection with the exercise showing the sap ducts, can you explain why cutting away the bark affects the growth of the tree?

Mulches of straw or other litter placed about trees may produce suitable winter quarters for field mice, and the injury from gnawing trees may be very severe. Air-slaked lime thrown in such litter close to the tree will help to reduce the work of mice. Rabbits and mice are also kept out by wrapping the trunks for a foot or two near the ground with tarred paper, veneer wood, or other suitable material.

3. Growing Oaks and Nut Trees.—In the fall, gather a few quarts of hickory nuts, acorns, peach pits, or other hard tree seeds. Spread them in a dry place for a few weeks. In a box ten or twelve inches deep, place a layer of sand or light soil, then a single layer of the nuts, then two inches more of sand. Continue until the box is filled, or until all the nuts are stored and well covered. Water the box well and sink it in the open garden in a well drained spot. If it is on the north side of an evergreen or other winter shade, it will be less affected by the hot sun towards spring. The whole box may be a few inches below the surface when covered. The soil should be heaped to drain off rain. In spring when the garden is ready for planting, remove the seeds from the box and plant each kind separately.

This method of starting acorns, nuts and peach pits is called "stratifying" them. The effect is to soften and crack the hard coats so the young seedlings may germinate.

4. Tree Seedlings in Tin Cans.—In summer or very early fall, transplant seedlings of several kinds of small trees started from seed in the garden the preceding spring. Maples, ash, basswood, or oaks may be used. The cans for this purpose should be well drained by punching many holes in the bottom with a large nail. Take the seedlings up carefully with plenty of dirt about the roots. Place them in the cans and fill with rich soil and firmly press it about the plants. Instead, tree seeds of several different kinds may be planted several in each can, and later the best plant may be kept and the others destroyed. These may be kept in the window of the school room or the home through the winter season. If the leaves should drop off from any, they may be plunged in the soil out of doors. All of them may be placed in garden rows in the spring by setting the cans a little below the ground and packing the soil well about them. The roots will soon make their way through the rusty cans and the trees will continue their growth.

When seedling trees are transplanted in full leaf they are apt to be killed or greatly checked by the process. If the tin can method above described is used the growth will continue unchecked. The plan may be varied by melting the bottoms and side seams of tomato cans, then tie a string around each "can" to hold it in circular form. Place the cans in a flat box to hold soil and do the planting as described. By this plan the roots find their way through the bottom of the can more readily, or the entire can may be removed by cutting the string when planting in the garden next spring.

Young trees that are transplanted in the old way will need pruning before they are reset (Fig. 88).

5. Forests on Hill Sides.—Select a sloping surface in the garden, either natural or prepared, by making a mound of earth a foot or two high and several feet across. Get moss from the woods and plant it on one side of this slope. Hold it in place by twigs of trees. Leave a part of the slope, or the corresponding side, perfectly bare but well packed. Use a garden sprinkler, holding it a few feet above the surface, and let water fall as rain upon the two surfaces for several minutes. Which surface is eroded or washed away more?

Hill sides on many farms are badly washed when not covered with growing vegetation such as pastures, orchards or forests. The washing may be checked by the use of the slope for one of these purposes. Gardens should be provided each year with a winter cover crop to avoid loss from washing, leaching or other causes.

6. Age of Woody Plants.—The older pupils or other persons may bring to school cross-sections of wood sawed from trees, posts or logs. Studies may be made of these, counting the number of rings of hard wood which alternate with rings of softer wood. Note the lines running in the direction of the spokes of a wheel. These are rays of different tissue running toward the bark.

In ordinary seasons of growth, a hard ring and a soft ring of wood are added each year. The age of a tree may be approximately determined by counting the layers or rings of hard wood between the center and the bark. The new rings are added each year outside the older ones, and the bark is pushed outward, year by year. This plan of growth is found in all native trees of the north and temperate zones.

FIG. 88.—Trees should be pruned before they are reset. (New Jersey Station.)

"Quarter-sawed" lumber is cut first through the center parallel to the "spokes" or rays running from the center. The beautiful quarter-sawed effect of lumber is produced by the exposure of the ray tissue on the surface.

7. Age Shown in Twigs.—Let each pupil have a branch of maple or other tree in winter condition. This should be examined closely to see the location of the buds. Note that they are found on the newest growth and seldom or never back of that. Each twig has a terminal bud covered with bud scales. The bud is to form the new shoot next season. As the shoot grows from the bud, the outside scales drop off, leaving scars which remain for many years at the base of each new shoot. Now, begin at the end of any twig and look back along it until the first ring of bud scale scars is found. This is where the growth began last year. Feel back again and find the beginning of another year's growth. Thus trace the twig back as far as you can and name the calendar year of each portion of growth. Note how much more growth was made some years than others. Can you account for this? Some seasons there would be a number of side branches formed from lateral buds. Perhaps other years there were none. The exposure to light often greatly affects the formation of shoots. Many buds may be broken off by storms, by sleet, by birds, or other natural causes. Perhaps some of the buds formed blossoms instead of shoots. The location of leaves on the last year's growth may be seen by the leaf scars under each of the buds. The new shoots next year will be the only ones which bear leaves. This causes the leaves of the tree to be near the outer surface.

The exercise is of value in the future study of pruning. Lessons of this kind may be studied 'neath the shade of a tree while resting from garden work (Fig. 89). Light has a

FIG. 89.—The spreading cherry tree furnishes welcome shade after the garden work is over.

strong effect in controlling the growth of twigs and forming the head of trees. Fruit trees often tend to grow too tall in the struggle between branches to reach the most light. Cutting back is thus made necessary. Abundant branching often causes the parts to rub, and wounds are formed. Thinning a brushy head is good practice. Abundant removal of twigs frequently has the effect of forcing growth in other parts. Thus the shape of orchard trees is readily within the control of the pruner.

CHAPTER XIV

CUTTAGE, GRAFTING, BUDDING, AND LAYERING

SCHOOL garden work offers favorable opportunities for a number of exercises in the propagation of plants by several different methods. Many of these can be carried on in the school room during winter weather or on stormy days when outside work is impossible. After the methods are learned much of the practice work may be done at home by both young and old. The products may be very useful.

1. Starting Slips.—In a shallow box of moist, clean sand, plant a number of cuttings or slips of such house plants as are grown in the window boxes and pots at school or at home. Try chrysanthemum, geranium (Fig. 90), begonia, carnation, fuchsia, and coleus. Keep the box in a moderately warm place and water the soil frequently. If the sun is bright, the box may be shaded by covering with a single layer of newspaper. The slips are made by cutting a few inches of the healthy shoots, usually using the tip portion. Remove much of the old leaf surface, even some of the newer leaves may be removed or reduced with scissors. After a week or so, lift out some of the slips by raising the sand about them. Do not pull them out. When the roots have become well formed, the slips may be transplanted to pots or well-drained cans of garden soil, and cared for in the usual way for house plants.

The student should understand that the leaf surface is reduced to prevent much of the evaporation until the roots are formed and able to take up moisture from the wet sand. Clean sharp sand is used, as it will not cause the rotting of the stems as garden loam would. Much interest will be aroused by these exercises, as new plants may be formed of so many different house plants.

2. Leaf Cuttings.—Make slips of leaves of such plants as begonia, sansevieria, or other fleshy-leaved plants. Either the whole or a portion of the leaf may be used, and the base of the blade placed in sharp wet sand and cared for as with stem slips. As roots are formed, new shoots or leaves will be sent up. The exercise may be varied by fastening a leaf with tooth-picks firmly against the wet sand. Roots will probably form at each place where the leaf is held down.

A storage of plant-food, such as starch, is present in fleshy leaves. This supplies nourishment to the new growth.

3. **Cuttings in Water.**—A number of kinds of green wood cuttings may be started by placing slips in water, without the use of

FIG. 90.—Starting geraniums for cuttings for window boxes. (Rittenhouse School Gardens.)

sand or soil. Try this with oleander, young willow shoots, "wandering jew" (tradescantia). Umbrella plant may be started in water by trimming half the leaf surface from one of the stems and inverting it in a bottle of water.

In each case, the water should be changed to avoid any rotting or fermentation which may tend to develop. After roots are well established by this method, they may be transferred to rich soil in well drained pots or boxes.

4. Hardwood Cuttings.—Cuttings of ripe wood six inches or more in length should be taken in the fall after the leaves have dropped. From some plants the cuttings may be made any time during the winter or early spring. Cuttings should be made from the newest growth and the strongest shoots are selected (Fig. 91). The cuttings may be tied into bundles of twenty-five to one hundred each, and a label placed with them. Store them in damp sawdust in a cold cellar. In late spring set them in furrows in the garden, with one or two buds showing above ground (Fig. 92). Press the soil firmly against them after setting. Simple hardwood cuttings should be made of grapevine, willow, spirea, dogwood, currant, gooseberry, hardy Japanese rose, and others.

FIG. 91.—Four types of hardwood cuttings. Many shrubs are propagated by some one of these types.

All woody plants are not readily propagated by cuttings, but gardeners have found that this method is the best for a great many kinds, in addition to those here mentioned.

5. Root Cuttings.—Dig up roots of blackberry, quince, horseradish, or rhubarb. These may be stored in wet sand in a cool cellar, if the season for planting has not arrived. In the spring, plant them in shallow furrows in garden rows. These should be cut into pieces, not too small, before planting.

With proper care, root cuttings seldom fail to grow. There is a store of starch and other plant-food in the roots of such plants as sprout from the roots. Adventitious buds on sprouts are formed on the roots near the cut surfaces and elsewhere. Shoots are sent up from these buds. The sweet potato is a true root and its growth when planted is explained in this way. Very many shoots are formed from a single sweet potato.

6. Grafting Wax.—The materials used are rosin, beeswax or paraffin, and tallow or linseed oil. Melt 1/2 lb. of rosin, 1/4 lb. of wax, and 2 oz. of tallow or linseed oil. These may be melted in any vessel suitable to stand the heat. The rosin should be melted first. When all are melted and thoroughly stirred together, allow the mass to cool a little and then pour it slowly into a pail of cold water. Let one pupil rub tallow on his hands and work and pull the mass of grafting wax as taffy candy is pulled, until it is of a light yellow color. Make it into rolls and lay on heavy, greased paper to harden.

Grafting waxes vary in composition. A larger proportion of rosin makes them harder. More tallow or oil makes them

FIG. 92.—When woody cuttings are set out they should be planted deep and the soil pressed well. The top bud should project above the soil.

softer. If the wax is to be used in cool weather it may be made softer. If for use in the hot summer sun it may be made much harder. Grafting wax is used in protecting wounds after pruning, in covering grafted and budded surfaces, and in waxing cotton or cloth for similar purposes.

7. Waxing Knitting Cotton and Cloth.—In the preceding exercise, while the wax is melted, put into it a ball of No. 18 knitting cotton. Press it with a stirring stick until the air is removed and the wax enters the ball of cotton. It may then be placed on a sheet of heavy greased paper to cool. Strips of old cotton cloth which will tear easily may be dipped in the melted wax and then removed to cool, or wax may be poured on sheets of cloth and spread with the stirring stick.

FIG. 93.—Root grafting of the apple. The seedling root and a twig from a good variety are first cut as shown, then slipped together, and then wrapped with waxed cotton

Pieces of the waxed knitting cotton, eight inches long, will be used to wrap around root grafts and budded shoots, to exclude the air from the wounds. Strips of the waxed cloth may be torn in any width desired and used in the same way. Weak cotton and cloth are used so they will not strangle the growth which follows the grafting and budding operations.

8. Whip or Tongue Grafting.—Use willow or other convenient switches to represent parts of the plant to be grafted. These may be cut fresh from trees in the garden or woods. With a sharp blade, make cuts as shown in figure 93. The two pieces should be fitted together as closely as possible, as shown in the picture. The long, sloping cut on each piece should be an inch or more in length. This gives long surfaces on the two while growing together. After placing together, the two parts should be snugly held by wrapping well with waxed knitting cotton.

Between the bark and wood of every woody plant is a layer of tissue called *cambium*, or growing tissue. If the cambium of the two pieces is in perfect contact, growth is likely to take place, otherwise they will probably not live.

The whip or tongue grafting is the method commonly used in making roof grafts of apples, pears, and some other fruits. The top shoots from good varieties are inserted upon roots produced by growing young seedling trees, as of apple, pear, and quince. The new tips are called scions.

9. Root Grafting.—Roots of apple seedlings may be obtained from a good nurseryman, or they may be grown in the school and home gardens by planting apple seeds from a cider press. Cut scions in fall or early winter from several good varieties of apple trees, taking only the thrifty growth of the past season. Pack the scions and roots in wet sawdust in a cold cellar until it is found convenient to graft them together. Take care to destroy all the seedling tips, as they will not produce good fruit. The scions and roots should be kept moist by the use of wet paper. The cut surfaces should be placed together before drying out, and must be made to fit firmly. As soon as the grafts are wrapped with waxed cotton or waxed cloth, store them again in wet sawdust in a cold cellar until late planting time. In late spring, plant the grafts in garden rows 4 feet apart, and 1 foot apart in the rows. Each graft should be placed beneath the ground with only a bud or two of the scion projecting.

Nurserymen make much use of root grafting as a method for propagating apples, pears, quinces, and some varieties of a few other fruits. The root grafting work is done during the winter season when other work is not pressing. It is considered a very satisfactory and sure method of propagation. If in any case the scion does not grow, the root is apt to send up shoots of its own. These must be destroyed, as they are not true to variety.

10. Practice in Budding.—Any time during winter or early spring, dormant switches may be stood in a jar of water in a warm room. This will tend to loosen the bark from the wood and make them suitable for budding practice. With a sharp knife, make cuts in the bark in the form of where the bud is to be inserted. Cut a "bud shield" bearing a single bud. Place the bud shield right side up firmly against the wood under the bark and wrap it firmly, as shown in U. S. Farmers' Bulletin 157.

Each student should make a number of buds in this way until some skill is attained.

The buds for grafting in actual practice are taken from budding stocks or scions from the new growth of trees of the desired varieties. The leaves are trimmed off, but stems are left near each bud to aid in handling when the bud is removed from the scion. The stems or plants where the buds are to be inserted are called stocks. As the budding operation is performed in the nursery or garden where the stocks are growing, the operator must get down close to the ground to do the work properly.

Fig. 94.—School boys budding young peach trees. (Rittenhouse School Gardens.)

11. **Budding Peaches, Plums or Cherries.**—In late summer or early fall, before the leaves drop, cut scions from known varieties (Figs. 94 and 95). Use the buds from these in grafting seedling plums or peaches of the current year's growth. Protect by wrapping well, as described in another exercise.

Stocks for this purpose are usually started from native seedling peaches, plums, or cherries. Special kinds of stock are, however, desired for a few varieties of plums and cherries (Fig. 96). The pits of peaches and plums are frozen over winter to crack them, or may be cracked by hand. Layers of the pits are covered with a little sand in the fall and left exposed to winter weather. In spring, they are planted in rows in rich garden soil and given thorough tillage until August or September, when they are to be budded.

FIG. 95.—Budding peach seedling trees with buds from good varieties. (Illinois Normal University, Normal, Ill.)

The pruning of a young budded tree consists in cutting away the tip above the new bud the following spring before the buds swell. This forces all the sap of the root system to the new bud, and the growth will be rapid. After one year's growth from the budding time, the trees should be transplanted to the orchard.

12. Spring Budding.—Select scions of budding stocks from twigs in a dormant condition. These should be stored until the stocks out-of-doors in the spring are in condition for inserting the buds. When the sap begins to flow and buds on trees are opening, the bark will loosen from the wood and budding can be done. The budding method for spring work is the same as that already described. The buds when inserted, should be well protected from the weather by use of wax and waxed cloth.

Fig. 96.—Mahaleb cherry stocks budded just above the ground in July and August, with buds from that year's growth on sweet cherry trees. These buds will remain dormant until the next spring. After they start into growth, the tops of the stock will be cut off just above the buds. (U. S. D. A.)

The use of spring budding may be to propagate good varieties on seedling stocks, or to change the variety on any older tree. In the latter case, a number of buds must be inserted at different places over the tree top, and pruning, to allow the new twigs to gain supremacy over the old ones, requires great attention.

13. Fruit Buds.—Bring to the school branches of plum, peach, pear and apple, showing both fruit buds and leaf buds. Compare these and learn to recognize fruit buds on trees in winter.

Where two or more buds are found together on the twigs of peaches, plums and cherries, the probability is that the larger buds in each cluster are fruit buds. These will form blossoms and bear the fruit of the coming season. On apples and pears the short spurs with strong buds at their tips are the fruit buds for the next crop.

14. Top Grafting Young Trees.—In the spring time, select an apple tree in the garden or at some home, which you wish to change into a good variety. The tree should not be too large. By the tongue graft method, insert a number of scions on twigs of the tree top. These scions should be from those stored the preceding fall or winter and held dormant in a cellar.

Older twigs near the grafts are pruned away to allow more sap to enter the newly grafted scions. This will force a more rapid growth. Many trees in an orchard are found to be undesirable because of mistakes in varieties, or other disappointments. In such cases, the tops should be grafted by the spring working method, as here described.

15. Top Working Old Trees.—Select a large, old apple tree which you wish to change to another variety. Cut a number of sound branches from different parts of the top. These should be about one or one and a half inches in diameter. A sharp saw is best for this, but care should be taken that the bark is not loosened from any portion of the stub. The cut surface may be smoothed with a sharp knife. Split the exposed end with a broad, thin chisel or grafting tool, and spread the opening so that a long tapering scion may be inserted. Two scions should be placed in each cut. It is a good plan to cut the scion so that the last bud will come just above the top of the cleft, and the scion is tapered by a knife on two sides to make it wedge shaped, but one edge of the wedge is thicker so the pressure of the stock will be greatest near the cambium layer. Cover all cut surfaces with a layer of hard grafting wax.

The scions for this purpose are selected and saved as in the preceding exercise. Cleft grafting is adapted to top working old trees and changing them to desirable varieties. Large branches can be grafted by this method. The best time for cleft grafting is in the spring just after growth has begun.

16. Tip Layering.—Bend the tip portions of a black raspberry bush to the ground and cover a few inches with a clod of soil. It is best to leave the end buds in each case projecting. After a few weeks these stems will take root and new shoots will start from the covered portion, and form new plants (Fig. 97). Cut the parent stems with shears or a knife. The young plants may remain where they are until late fall or spring and then be transplanted to new garden rows.

This method is called tip layering and is a common method practiced for propagating black raspberries. It may be successfully tried with a number of other plants. Climbing roses are often propagated in this way.

FIG. 97.

FIG. 98.

FIG. 97.—Black Raspberry bushes may be propagated by tip-layering. This is done soon after the crop is picked.

FIG. 98.—Clematis, grape, ivy, and many other vines may be propagated by layering them during the growing season.

17. Vine Layering.—Make a shallow furrow with a hoe or spade near a grape-vine. Lay in it one of the canes its full length. Cover parts of it, leaving other parts exposed to the light. Shoots will start up and roots will be formed in a few weeks (Fig. 98). The new plants may be cut apart with a spade. They may be transplanted to desired places as soon as the leaves disappear, or early the next spring.

Several kinds of vines, including the Boston ivy, Virginia creeper, and certain varieties of grapes are commonly propagated by vine layering. It is an easy and sure process.

18. Mound Layering.—Mound up soil among the root stems of a gooseberry bush. After a few weeks, new roots will be formed on these branches in this mound of soil. The following fall or spring, the plants may be dug. The branches with their new roots will form new plants. These may be cut or pulled apart and set separately in a new place in the garden.

Gooseberries, quinces, and many ornamental shrubs, such as lilacs, may be propagated by mound layering. To some extent, this process takes place accidentally when soil is thrown up against plants during cultivation.

Number of Shrubs or Plants for an Acre

Distance apart	No. of Plants	Distance apart	No. of Plants	Distance apart	No. of Plants
3 x3 inches	696,960	4 x 4 feet	2,722	13 x13 feet	257
4 x4 "	392,040	4½x 4½ "	2,151	14 x14 "	222
6 x6 "	174,240	5 x 1 "	8,712	15 x15 "	193
9 x9 "	77,440	5 x 2 "	4,356	16 x16 "	170
1 x1 foot	43,560	5 x 3 "	2,904	16½x16½ "	160
1½x1½ feet	19,360	5 x 4 "	2,178	17 x17 "	150
2 x1 "	21,780	5 x 5 "	1,742	18 x18 "	134
2 x2 "	10,890	5½x 5½ "	1,417	19 x19 "	120
2½x2½ "	6,960	6 x 6 "	1,210	20 x20 "	108
3 x1 "	14,520	6½x 6½ "	1,031	25 x25 "	69
3 x2 "	7,260	7 x 7 "	881	30 x30 "	48
3 x3 "	4,840	8 x 8 "	680	33 x33 "	40
3½x3½ "	3,555	9 x 9 "	537	40 x40 "	27
4 x1 "	10,890	10 x10 "	435	50 x50 "	17
4 x2 "	5,445	11 x11 "	360	60 x60 "	12
4 x3 "	3,630	12 x12 "	302	66 x66 "	10

Suitable Distances for Planting

Apples—Standard........................25 to 40 feet apart each way
" Dwarf [bushes]................. 10 " " " "
Pears—Standard.........................16 to 20 " " " "
" Dwarf......................... 10 " " " "
Cherries—Standard......................18 to 20 " " " "
" Dukes & Morrellos............16 to 18 " " " "
Plums—Standard.........................16 to 20 " " " "
Peaches................................16 to 18 " " " "
Apricots...............................16 to 18 " " " "
Nectarines.............................16 to 18 " " " "
Quinces................................10 to 12 " " " "
Currants............................... 3 to 4 " " " "
Gooseberries........................... 3 to 4 " " " "
Raspberries............................ 3 to 5 " " " "
Blackberries........................... 6 to 7 " " " "
Grapes................................. 8 to 12 " " " "

To estimate the number of plants required for an acre, at any given distance, multiply the distance between the rows by the distance between the plants, which will give the number of square feet allotted to each plant, and divide the number of square feet in an acre [43,560] by this number. The quotient will be the number of plants required.

CHAPTER XV

INDOOR PLANTS

Window Gardens.—Any home or school-room may be made more enjoyable by the use of plants grown in pots on tables, shelves, window-sills, or in racks and baskets suspended from above. Houses of rich and poor alike are handsomely adorned by well-grown window gardens. For people without yards, and for all in the winter season, a window garden is a great luxury. House plants, either in the home or in the school-room, add much to the beauty, contentment, cheeriness and interest. The time and attention required to keep a choice collection of house plants in thrifty condition is small compared with the pleasure gained. The choice location is near the bright sunlight of a large south window for geraniums, coleus, fuchsia and the heat-loving plants, but there are a number of house plants such as ferns, pansies, English ivy, umbrella plant, oleander, and some of the bulbous plants that do as well by the north window, and in the cooler parts of rooms.

For the beginner, the best plan is to start with a very few plants at most. Try a geranium or two, or an umbrella plant, or a few bulbs, or an English ivy. After some experience and success have been attained, a larger collection may be tried.

Flowering plants of many kinds may be kept in the windows constantly or throughout the winter season. Tea roses and their hybrids, geraniums, fuchsias, begonias, lantanas, oxalis, amaryllis and sweet violets are among the perpetual bloomers of the perennial type.

Annual-flowering plants commonly grown to blossom indoors are: Cyclamen, gloxinia, primula, cineraria, crysanthemum (Fig. 99), carnation (Fig. 100), and others.

Flowering bulbs are among the most attractive house plants and the dry bulbs may be started into growth and forced to blossom at any time desired. Among the common bulbs are Dutch and Roman hyacinths, narcissus, jonquils, tulips (Fig. 101), crocus, freezia, calla lily, Easter lily, and others. Amaryllis, hippeastrum, tuberose, and lily-of-the-valley may be used as indoor plants.

FIG. 99.—Chrysanthemums are among the most satisfactory flowers to grow indoors. (U. S. D. A.)

Forcing Bulbs.—A number of kinds of bulbs may be made to bloom in window boxes, hotbeds, or living rooms in winter. Hyacinths, some kinds of daffodils and Chinese sacred-lilies are commonly used in window gardening in homes and schools.

The bulbs for winter forcing should be planted in moist,

FIG. 100.—Carnations make good house plants for home or school. (U.S.D.A.)

light soil in well-drained pots, cans or boxes and kept in a cold place, as a dark, cool cellar, until a few weeks before the time the flowers are desired. They are then placed in a warm room and the growth is forced. The forcing should not be too rapid. During the period in which they are kept in a cold

FIG. 101.—Tulips naturally bloom in early spring out-of-doors, but they may be forced into bloom in midwinter if desired. (U. S. D. A.)

place roots will have formed in the soil, and strong vigorous shoots will perhaps show above the ground. If there be a tendency for the bloom to form too close to the surface of the soil, the stem may be caused to lengthen a little by placing a pasteboard cylinder around it. The light is thus excluded except at the top. A window box or number of pots for winter flowering bulbs add much to the pleasure and value of school work.

Non-blooming plants, or those grown for the beauty of the foliage are: Coleus, asparagus ferns, true fern, cactus, palm, auricaria, ice plant, spiderwort, Kennilworth ivy, English ivy, century plant and others.

Plant Holders.—House plants may be grown in window boxes, earthen pots on shelves or window-sills, tin cans, wooden or wire baskets suspended from brackets, glass bulb-dishes, and many other styles of holders. Probably the most satisfactory form of window box is a shallow wooden box lined with lightweight galvanized metal. The length should be such as to fit the window or other location desired; the width may be eight to twelve inches inside; and the depth from four to eight inches inside. The bottom should be provided with one or more drain tubes from which the drainage water may be caught when necessary to prevent the wetting of window sills, walls and floors.

It is a good plan to grow the plants in regular flower pots or in tin cans with good drainage holes in the bottom. Then place the pots in the window boxes instead of on the bare window-sills.

The metal-lined boxes will catch the drainage and protect the room from much litter. The plan of having the potted plants in a window box is a decided improvement over the older method of planting directly in the soil of the box. If the pots are to be used the boxes may be very shallow and may be as wide as can be readily supported on a pair of brackets level with the window sill.

Such household articles as tin cans, small buckets, small boxes, etc., give very satisfactory results. These may be painted or stained a suitable color, as dark green, or they may be covered with green crêpe or other paper. When such vessels are used for growing the plants, they should be provided with suitable drainage holes in the bottom, as nearly all house plants require well-drained soils. Watering can then be more liberal and with less danger. Showering the plants with a brush or whisk broom dipped in water, is very useful in washing the surfaces of the leaves. It improves both the health and the appearance of the plants. The showers are easily given if the pots are kept in shallow window boxes. The use of saucers under the flower pots is a great protection to the window sills if the shallow boxes are not used. Tubs are used for large ferns, palms, oleanders, India rubber plants, century plants and others that are too heavy for earthen pots. Such large plants are often kept on the floor. In such cases the drainage holes should be in the sides just above the bottom instead of in the very bottom. Metal trays may serve as saucers under the tubs.

Water-loving plants, such as the umbrella plant, wandering Jew, narcissus, jonquils, water hyacinth and others, may be grown in pots of soil which are then set into jardinieres of water in metal-lined boxes containing a few inches of water. Glass dishes, for some of the water-grown bulbs, are often provided with coarse sand and gravel immersed in the soil to hold the bulbs and roots in place.

The Self-supporting Aquarium.—In schools and houses where there are small children, an aquarium containing several kinds of water plants and water insects and small fish may well be a permanent part of the window garden. Such an aquarium is shown in figure 41. The animals in it are provided with their necessary oxygen by the growth of the water plants in the presence of bright sunlight. The plants use up the carbon-dioxide given off by the little animals and obtain much of their food from this source.

Window Vegetable Garden.—In many homes and schools the window spaces could be used much more than they are for the growing of plants for the vegetable garden. Early vegetables that can be transplanted may be started in shallow boxes of soil. They will be ready to be transplanted to the spring garden somewhat later. In this way the windows may take the place of a hotbed in helping to start the spring garden much earlier.

Among the earliest vegetables to start in the window boxes would be cabbage, cauliflower, lettuce and spinach. Later on we may start tomatoes, peppers, egg-plants, celery, sweet potatoes, cantaloupes, and later plantings of the early group. Parsley may be planted in the fall and grown in a window all winter. It will furnish garnish and flavor for table use whenever desired.

There are some things, such as radishes, that may be grown to edible size in the boxes. Gourds, cucumbers, and sweet potatoes may be grown so large as to be very pretty in the group of window plants. For this purpose they should be transplanted into pots and well cared for as individual specimens.

CHAPTER XVI

THE GROWING OF VEGETABLES

Farmers' Gardens.—Home vegetable gardens on farms are not given much attention. Usually a farmer thinks he cannot spare the time to take care of the garden, so he plows up a little "patch" near the house and lets the already overworked housewife care for it. The garden should be large enough to provide an abundance of vegetables for the family. If it is laid out with rows wide enough apart, most of the hard work may be done with a horse. The planting and raking are not so irksome. Young people are glad of an opportunity to plan, plant and care for the home garden.

Have the garden near the house, so it will not be much bother to get the products when needed. It may be best to fence it with chicken netting that is tight enough to keep all fowls out. Then, don't plan to do all the work after supper, when already tired. Take some time from the regular field work, and cultivate the garden as it should be cultivated. It will pay, not only in satisfaction, but also financially.

The average of city gardens, grown on cramped plots, would grade higher than those found on the average farm. City men frequently have to do all the digging and cultivating by hand, but at that they do a better job than the farmers. The poorest gardens are often in the country, where one would expect to find the best. Farmers have a right to the best things of life, and fresh vegetables come under this classification.

The suggestions and directions regarding culture and management of the garden crops are arranged in alphabetic order for convenience in reference. Probably the whole list would not be grown in many of the gardens. Selections can be made to suit conditions. For very small school plots the list from which we should select would probably be limited to:

Beans, beets, carrots, sweet corn, egg-plant, endive, kale, lettuce, onion, parsley, parsnips, peas, peppers, radish, Swiss chard, spinach, tomato and turnip.

Artichoke.—The plant is perennial, but is grown from seeds. Suckers from the best plants may be taken off and set in garden rows about three feet apart each way.

The plant is said to be of French origin, and is sometimes called French artichoke to distinguish from the Jerusalem artichoke. The flower heads are edible. Fleshy scales from the sides and lower part of the head are used for salad or cooked like asparagus.

In the northern states, winter protection in the form of leaves or other litter is required to prevent winter killing. Edible heads may be obtained the second or third year from seeding.

Artichoke, Jerusalem.—This plant belongs to the sunflower family and has potato-like tubers which may be used in the propagation of the plants. They are hardy perennials. Even the tubers will stand freezing in the ground. The tubers are edible, being much relished by all who have learned to like them. They are also frequently used as roots for hogs. For the latter purpose they may be planted where hogs can pasture in late fall.

Asparagus.—The crop is one of the earliest of spring vegetables, and should be found in every school garden and home garden. For school gardens, the best plan is to get strong plants and set them in rows three or four feet apart, with the plants eight to twelve inches apart in the rows. Asparagus needs rich, well-drained soil, but the plant thrives best with a large quantity of stable manure. This should be placed on top after planting, and more added each fall for the young shoots to come through in the spring. The planting should be deep enough to leave the crowns four to six inches below the surface. Each fall, before top dressing with manure, the surface above the crowns may be plowed or spaded over.

Asparagus may also be propagated by seeds, but this method requires two to four years to make the first crop.

The most injurious enemy of asparagus is the rust disease, and no satisfactory remedy has yet been found. Two varieties are popular, Palmetto and Conover Colossal (Fig. 102). The latter is perhaps more resistant to rust.

FIG. 102.—Colossal asparagus is a good kind to sell. Here the stalks are 12 inches long.

Beans.—There are many different kinds and varieties of beans. They are all annuals, and so tender that they cannot withstand frost. Seeds should be planted in the open garden after all spring frosts are over. Light, warm garden soils are the best. All garden sorts are grown in rows 2½ to 4 ft. apart, and in the rows may be either in drills or in hills. The seeds have strong germinating power and may be planted two to three inches deep, with the soil well firmed over the row after planting. Beans may be divided by the nature of the plants into two groups: (1) Bush beans; (2) pole or climbing beans. As to use, they may be divided into: (1) Dried beans used for cooking after they are ripe and cured; (2) shelled beans, such as limas, the beans being shelled from the pods before cooking; (3) snap or string beans, the entire pod and contents being cooked and eaten.

For school gardens, snap beans will prove most popular.

The crop comes quicker and is thus more satisfactory. For the best use of limas and snap beans of different varieties, the garden should be cared for during the summer. The crop will pay for the trouble of summer care.

The culture is easy, and the growth will be thrifty in rich, warm soil. A good dust mulch should be kept about the plants with a garden rake or cultivator. The bush varieties of limas (Fig. 103), and the bush or low varieties of snap

FIG. 103.—Bush lima beans are easier to manage than the pole limas, but the yield is less. (New Jersey Station.)

beans (Fig. 104), suit the school garden best, as the poles for staking are not necessary. Any climbing varieties, as Kentucky Wonder, may be planted in the rows of sweet corn after the corn is well started. The vines are allowed to climb on the corn.

Beets.—The beets are truly biennials, not bearing seed until the second year; but as the crop consists of the fleshy roots it is a quick producer for the school garden. Seeds may be sown in rich garden soil in very early spring. It is well to soak the seeds for a few hours in slightly warm water just before planting. This softens the hard seed cases and hastens germination. Seeds should be covered about one inch or less. A very early crop of garden beets may be produced by planting the seeds in hotbeds in late winter or very early spring. If the weather is warm enough when the plants are large enough to be thinned, the thinnings may be transplanted to the open garden. For early use, the best table beets are the flat or turnip-shaped varieties. For a long season of late beets, long red varieties are best. They suffer less from dry summer weather. The true sugar beet is shown in figure 105; the flesh is usually white.

Fig. 104.—Early stringless wax beans, variety Wardwell's. (Cornell Reading Circle Leaflet.)

Keep the soil well stirred between the rows and do not let the growth be checked by drouth or other causes.

Beet tops are often used to cook as greens, yielding a crop for this purpose very quickly. This is another reason for using beets in the school garden.

Beets and other root crops should not be grown in the same part of the garden two years in succession, because of the danger of scab disease.

Broccoli.—Broccoli is similar to cauliflower, and is not much grown in American gardens. It is well suited to late summer planting, and might be used in the school garden to produce a crop during the fall term. It should in this case be started by setting the plants, like late cabbage or cauliflower, in July or August. The soil and its care are the same as for cabbage.

Brussels Sprouts.—This is also suited as a fall term crop in the school garden. The plant is grown for the small immature cabbage heads, called sprouts or buttons, formed on the sides of the stems. These sprouts are very tender and much relished when properly cooked.

FIG. 105.—Sugar beets are often grown in gardens for use of pigs, poultry and other stock. (U. S. D. A.)

Seeds may be planted in hills in spring or midsummer, or the plants may be started in beds and transplanted to the garden 2½ to 3 ft. apart each way. Dwarf varieties may be set much closer. The more mature sprouts may be used as soon as large enough, and the remainder left in the garden until November or December. They endure much frost.

Cabbage. — Cabbage seed for early varieties may be sown in window boxes or hotbeds a few weeks before it is time to transplant them to the open garden. The transplanting should be done early so that much of the growth may be made before hot weather. Properly hardened cabbage plants will stand some frost. Early Jersey Wakefield and Early Charleston Wakefield are two of the most popular early varieties. The plants may be set two feet apart in rows three feet apart. The culture should be clean and thorough. Considerable manure and fertilizer should be worked into the soil before or after planting. For use in the fall garden, late cabbage should be started from seed, or transplanted plants set in the garden in mid-summer. Several varieties are used for the late crop, such as Late Flat Dutch and Late Drumhead.

Cabbages should be well watered, and the culture must be thorough enough to prevent any check in the growth of the plants. Compare the heads in figure 106.

The late crop is very hardy and will stand severe frost.

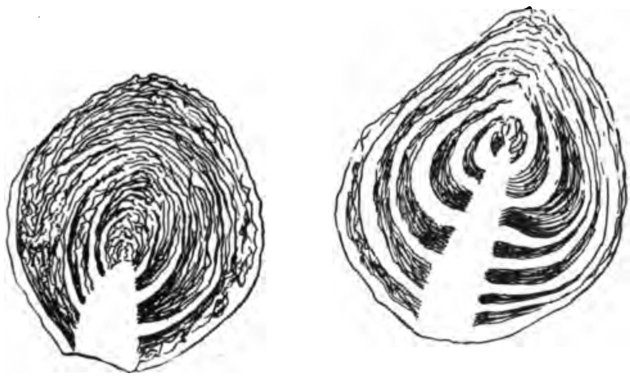


Fig. 106.—A good cabbage head should be well filled and will then feel solid. The one at the right is not fit for market.

The crop from the school garden may be disposed of when the ground begins to freeze. For home use, the crop may be stored in cool moist cellars. Pulling the plants and setting the roots in boxes or trenches of soil in a cool cellar has proved to be a successful method of storage.

The worst enemy of the cabbage crop is a worm produced from eggs laid by white cabbage butterflies. For treatment see "Cauliflower."

Carrot.—Seeds of the extra early varieties may be planted in shallow drills in the hotbed in late winter. The seed may be sown in the open garden as early as the soil can be worked in the spring. Half long varieties are the most desired in the market (Fig. 107). The soil should be rich and mellow, and the culture thorough and deep. For a school garden crop in the fall, seeds may be sown early in July. Use the long variety. These should be sown thick and the plants thinned to a distance of three or four inches in the row. The distance between rows should be enough to allow proper cultivation.

Carrots are used to boil with other vegetables in a "boiled

FIG. 107.—Two types of carrots, Improved Rubicon (left) and Danvers Half-long (right), showing how they are bunched for market. (Cornell Station in Productive Feeding.)

dinner," or they may be cooked separately and served as a side dish with cream sauce and seasoning.

Cauliflower.—For an early crop, raise plants by sowing the seeds very shallow in a hotbed or window box. These may be transplanted first to coldframes two inches apart each way and set in the open garden as soon as the soil is fit to work. The soil should be very rich and fibrous and well supplied with humus and moisture. Plenty of water should be applied when the weather is dry, particularly at heading time. Light applications of such fertilizer as nitrate of soda and sulfate of potash are of much help. Avoid putting these too close to the plants. Two feet apart each way is a suitable distance for plants in school gardens. When heads have formed they require blanching. This is done by drawing the outer leaves together and tying with raffia or strips of soft cloth. Early Snowball and Dwarf Erfurt (Fig. 108) are popular varieties of early cauliflower.

For late cauliflower to mature during the fall term in the school garden, the plants may be started in open ground

FIG. 108.—A small head of cauliflower of fine quality. (Cornell Reading Circle Leaflet.)

like late cabbage. The heads require blanching as for early cauliflower. Autumn Grant is a good late variety.

Cauliflower is attacked by the cabbage worms, which may be combated in several ways. Dusting the young plants with such powders as wood ashes, fine road dust, air-slaked lime, or any mixture of these with or without Paris green will aid in keeping the adult white butterflies from laying their eggs on the plants. The dusting is done in early morning while the dew is upon the plants.

Celery.—The late crop of celery is best suited to the school garden. Seeds may be started in window boxes or in the open ground. The plants are later set 10 inches apart in rows

4 feet apart. The soil should be rich and black and in the highest state of cultivation. Growth should be forced by plenty of thorough cultivation and watering during dry weather. Celery requires blanching after the growth is nearly completed. This may be done in the open garden by mounding up the soil to within a few inches of the tops of the leaves. If the crop is to be stored the blanching may take place during storage. The plants are lifted and reset in deep boxes containing a little soil. These are set in a cold place without light. The leaves are left exposed to the air and the stems are so well shaded that they become well blanched. A little watering may be necessary if stored by this method. Giant Pascal, Golden Self Blanching and Evans Triumph are popular varieties.

Celery blight is the worst enemy of this crop. It may be controlled by spraying before the disease obtains a "foothold" with Bordeaux mixture. No poison is necessary in the spray for blight.

Corn, Sweet.—Schools having no summer session do not have the privilege of harvesting the early varieties of sweet or sugar corn. Such late varieties as Stowell's Evergreen, Mammoth Late, may be harvested after the school reopens in the fall.

Seed is planted in good garden soil in rows three to three and a half feet apart. The plants may stand singly about one foot apart or three together in hills three feet apart. The soil should be well tilled and a fine dust mulch maintained throughout the growing season. The worst enemy of sweet corn is the ear worm. Methods of dusting the growing plants with lime are being recommended. Dense clouds of lime dust are produced about the time the tassels and silks are formed. This should be repeated for several weeks if washed off by rains. Fall plowing of the ground also helps to destroy the winter stage of the ear worm. For the early spring garden, sweet corn may be planted as soon as danger of frost is over.

Country Gentleman is one of the best of medium season. Very early varieties are Golden Bantam, Crosby's Early, and Adams' Extra Early.

Cucumbers.—This crop is used both for early slicing and for putting down as pickles. The late crop is perhaps best suited to the school garden. The soil must be made as rich as possible, and the growing plants may be watered with liquid manure, prepared by keeping a supply of stable manure in a barrel of water.

The seeds are planted in June or early July in hills four to six feet apart each way. They usually require some protection from striped beetles and flea beetles. Bordeaux mixture with poison added is sometimes successful. Dusting the plants with material, as mentioned under "Cauliflower," is helpful. Danger from these enemies may be largely overcome by forcing growth with good tillage and plenty of liquid manure. As the cucumbers become large enough for use, they should be picked daily. Allowing them to ripen on the vines prevents the formation of others. If the picking and watering are done well, the crop may be kept until frost.

Cucumbers for winter use may be "salted down" for future pickling by placing them in jars or other vessels with alternate layers of salt for a day or two to extract the moisture. They are then transferred to full strength salt brine and kept as long as desired. The pickling may be done at any time by placing them in vinegar. Before placing them in vinegar the salt must be thoroughly soaked out by allowing them to stand in fresh water for several twelve-hour periods, using fresh water each time. For sweet pickles, the pickling fluid is made by boiling a gallon of vinegar with two pounds of brown sugar, and spices are added to suit.

Egg-plant.—The egg-plant (Fig. 109) is sometimes called "guinea squash." It is becoming more popular in many sections of the middle states and southward. The plants are tender and must not be set in the open garden until warm weather. Seeds may be started in the hotbed or window box and transplanted once before setting in the garden. The plants are set three feet apart each way. Egg-plant seed requires a higher temperature for germination than any other vegetable, and much heat is required for continued growth. The soil can hardly be made too rich. Clean culture is desired, as the plants must be kept growing steadily. Water them with liquid manure during dry weather. The leaves

FIG. 109.—Black Beauty egg-plants. The boy is justly proud of his crop. (New Jersey Station.)

are attacked by potato beetles and flea beetles. They should be sprayed as for potatoes, and dusted as the cabbage, cauliflower and cucumbers.

A favorite way of preparing egg-plant for the table is to soak the slices in weak salt solution for half an hour and then roll in bread or cracker crumbs with egg, or dip in batter and fry.

Endive is a late fall vegetable used for salad. It resembles curly lettuce. The late crop may be started from seed in June or early July. If the seeds are started in boxes the plants may be set in the garden when two or three inches high. Leave room between the plants for culture with hand tools. When nearly full grown, they must be blanched before they are fit for the table. To accomplish this, the outer leaves are tied together with soft material to exclude the light from the inner leaves. This must be done when the plants are perfectly dry to avoid rotting. They may be blanched by other methods used for celery. The time required for blanching is three or four weeks.

Fig. 110.—Horse-radish is started by setting small roots such as those shown here (Cornell Reading Circle Leaflet.)

For early use the seed may be sown in spring as soon as the ground is fit to work.

Garlic is similar to onion, and the bulbs are used for flavoring soups and similar purposes. The plant is popular in localities settled by foreigners from southern Europe. Garlic is multiplied by combined or clustered bulbs which may be taken apart and planted separately. Each part makes a new group in a few weeks. The plan is similar to that practiced with multiplier onions. Garlic is so hardy that plantings are made out-of-doors in the fall throughout the southern states. In the north, early spring is better. Leave the plants two inches apart in the row and enough space between the rows to allow for either hand or horse culture.

Horse-radish (Fig. 110) is well known as a condiment or appetizer. The roots are perennial, and when once established in a garden will persist indefinitely. They may be started by setting small fingerling roots or pieces of roots. The upper ends of the roots when set should be three inches below the surface and covered with loose but rich soil. A permanent horse-radish bed should be in some corner out of the way. Roots may be dug late in the fall before the ground freezes. If the whole crop is then taken up the smallest pieces may be used next spring for replanting. The roots are grated or ground and after treating with white vinegar, are bottled for market or for future use. School boys may easily make their first start in commercial gardening by the use of this crop.

Kale and Collards.—The kales are well adapted to use in the school garden. They are so hardy that much use can be made of them in late fall, winter and early spring. They make excellent greens, and seem to be improved by frost. For early spring use, sow the seed in September and protect the plants during winter with clean litter of some kind. In latitudes north of New York City, a better plan is to sow the seed in early spring, or the plants may be started in hot-beds and transplanted. During mild winters and in southern states, kale may be used for greens throughout the entire winter season. Culture and soil are the same as for cabbage.

Kohl-Rabi.—Drill seed in rows sixteen to eighteen inches apart and thin to four inches between plants. The plants develop quickly and are well suited to use in the school garden. Successive plantings may be made until mid-summer.

The edible part is a swelled part of the stem a few inches above ground, which is bulb-like in appearance. It is likened in appearance to a leafy turnip. The preparation for the table is similar to that for turnips.

Leek.—Sow in early spring as soon as the ground is fit to work. The rows should be about one foot apart, and the seed covered to a depth of one inch. The plants may be moved when six to eight inches high and set in deep rich soil, about six inches apart in the rows. When transplanting, set the plants deep to blanch the necks, and ridge up the soil as growth continues. Another plan suited to the school garden is to start the seeds in early September, leaving the plants in the drill rows until spring. Protect during winter weather with leaves or other litter. They may be thinned or transplanted as early in the spring as possible. Leek is used for the same purposes as garlic, and by the same people.

Lettuce is well adapted to use in the school garden. It is the most popular of all American salad plants. The crop can be produced at any time of the year, and within a very few weeks. The following plans are suggested:

(1) In early fall, when school first opens, sow the seed in open ground and mature the crop there.

(2) Later in the fall, sow the seed in a coldframe and mature the crop in the coldframe before Christmas.

(3) In late fall, sow the seed in coldframes or window boxes and transplant to a hotbed, maintaining a cool temperature until matured.

(4) Start seed in a hotbed in late winter or early spring, transplant or thin the plants in the drill rows and mature them in the hotbed.

(5) In early spring start the seeds in window boxes or a hotbed and transplant to the open garden as soon as the ground can be worked. For this purpose, the seedlings should be kept in a very cool condition for a week or so before transplanting. This is called "hardening off."

(6) As soon as the ground can be worked in the spring, start seeds in the open and either transplant the seedlings or thin them in drill rows, leaving them there until mature.

There are three main types of lettuce, the loose-growing, head lettuce, and Cos, or upright lettuce. Head lettuce is most popular for salad purposes in America, and this type should always be thinned or transplanted to six or ten inches so it will not crowd. Cos lettuce is probably the most popular form in Europe. It requires blanching to be of best quality, otherwise it is used merely for garnishing. It is better suited to summer growth than the other forms.

Mushrooms.—Schools or homes having cellars or dark buildings not in use may well try the growing of mushrooms. They form a delicious esculent and are considered a luxury by many. The crop is a very precarious one to grow. "Spawn" used for propagation may be obtained from seedsmen and full cultural directions are usually furnished.

Muskmelons are not as well adapted to growth in the school garden as more hardy plants. They thrive only in the warmest summer months. They do best in light, rich soil and pay well for heavy applications of stable manure. Culture and care are much the same as for cucumbers. The seeds should not be planted in the open garden until the weather is quite warm. Twelve to fifteen seeds are thinly planted in a broad hill. This allows for the killing of some plants by the flea beetles and striped beetles. After danger from these enemies is past, the hills may be thinned to two or three plants.

A few hills of muskmelons may be started by planting in pieces of sod in hotbeds or window boxes. These are transplanted to the open garden when warm enough. Repeated sprayings with Bordeaux and arsenate of lead mixture is advisable for cucumbers, muskmelons and squashes.

Melons with green flesh, such as Netted Gem, are highly flavored, but are not so attractive in appearance as Osage, Emerald Gem, and others with salmon flesh. (Fig. 111.)

Okra, or Gumbo.—This hot-weather plant is extensively grown in southern states for its green pods, which are used in soups and stews, giving a rich flavor.

The seed is sown in rich garden soil in late spring afte. danger of frost is over. Rows should be three feet apart and the plants thinned to ten inches apart in the rows. Clean culture should be practiced, as for corn.

Onion.—The school garden can grow early green or bunching onions. The plan would be to sow the seed of Silver Skin or other hardy white varieties in early August in well-prepared and well-drained rich soil, leaving the rows one foot apart. In latitudes southward from New York they winter well, at least with slight mulching of clean litter. This crop is ready for use or bunching for market in early spring.

Plant some sets of Egyptian or perennial tree onion about September 1st for bunch onions early the next spring.

For the fall crop of onions, sow seed in early spring in very rich, clean, well-drained garden soil. The rows should be fifteen inches or more apart to allow for cultivation. The plants should be thinned to at least two inches apart in the rows. Clean culture with wheel hoe or garden rake should be practiced throughout the summer, or until the bulbs are nearly mature. When the tops begin to die down, the onions should be pulled and well dried to cure them. They may be sold immediately or stored for future use in a cool dry place.

FIG. 111.—Cantaloupes for the market should have abundant, deep netting with the ribs not prominent. Select seeds from such specimens. (North Carolina Department of Agriculture.)

For a crop of onion sets, sow seed in drill rows in very early spring, in soil similar to, or poorer than, that used for bulbs, and give less culture. Gather the sets when ripe, cure, and store them in a dry, airy place. If thoroughly dry, they will stand slight freezing during the winter.

The next spring, these onion sets, or others purchased for the purpose, may be planted a few inches apart in rows twelve inches apart. The sets are covered with moist soil, well packed. These will produce green onions for early use or for bunching to sell in a few weeks from the time of planting.

In a hotbed, onion sets may be forced at any time during the winter or early spring.

Onions are classified according to color as yellow, white, and red. Sets and seeds of each of these colors may be selected to suit the taste or market requirements.

Parsley is universally used as a garnish with meats or other dishes. It is also used in seasoning soups. As a garden plant, the seeds may be sown in rich mellow soil in very early spring. Thin out the plants to stand six inches apart and have the rows one foot or more apart. Before sowing, the seed should be soaked a few hours in warm water. Leaves may be taken from the growing plants at any time when they are large enough for use. A strong plant may be transplanted from the garden to a pot or window box and kept growing in the house for winter use. It should be well watered and given a light exposure. Other plants may be transplanted from the garden to a coldframe and thus protected for use next spring.

Parsnips are so hardy that they are well adapted to use in school gardens. Drill the seed in the open garden as early as the weather will permit. The rows may be eighteen inches apart and the seed covered to a depth of one and a half inches. The soil should be rich and well drained. When the plants are up, thin them to a distance of three to six inches apart. Clean culture should be given, and the growth well maintained throughout the dry weather. The roots may be used in late fall, but the quality is improved by leaving them in the ground over winter for spring use. This makes them sweeter. Enough of them may be taken up and buried in pits or cellars in the fall for winter use.

Peas.—Early garden peas are never forgotten by the spring gardener. Plant them as early as possible. The smooth varieties, such as Alaska, New Claudit and Tom Thumb, may be planted the earliest. The wrinkled varieties are later and not quite so hardy. In the school garden it is suggested that varieties be grown which do not need brush or other support. By selecting different varieties and planting them at different times succession, a supply of green peas may be produced until late hot summer. Peas do not thrive in hot weather. To plant the seed, furrows three or four inches deep and three feet apart are made, and the seed is scattered in them

Fig. 112.—Sweet peppers are prepared for the table in a number of ways and are becoming more popular every year. (New Jersey Station.)

and covered with a hoe or plow. The culture is similar to that given to corn and beans. Varieties requiring stakes or brush may be planted in double rows, one line of support serving for both rows. The soil should be rich, as good yields cannot be produced on poor soil.

Pepper.—Garden peppers (Fig. 112) are hot-weather plants. The large fleshy varieties are known as sweet peppers and are found in the summer market. The small hot peppers are used in soups and sauces for seasoning. The plants may be started in hotbeds or protected places and transplanted when the weather is warm enough. The distance, soils, and culture are similar to those mentioned for egg-plant.

Potato.—The common white or Irish potato is recommended for use in school gardens because of the lessons to be learned in growing it. Experiments showing the principles of plant growth and plant breeding may be carried on best with the potato. The soil for potatoes should be of a medium or light loamy character. It should be well supplied with an abundance of available plant-food, rich in nitrogen, phosphoric acid and potash. The plowing should be very deep to allow the roots to penetrate the soil well. The pieces of seed potato may be dropped in drills and covered to a depth of three or four inches below the level surface. The distance apart may be from twelve to sixteen inches, according to the number of eyes on the piece. The distance between rows should be two and a half to three feet, to allow of easy horse cultivation. Tillage should be frequent and the surface kept level or nearly so. A good plan is to cut the pieces to leave about three eyes on each. The seed potatoes should be treated with a preparation of formalin before planting (see exercise explaining the method). The best method of selecting seed potatoes is described in another chapter. (See exercise under this title.)

For the school garden a very early variety may be started as early as the ground can be worked. Early Rose, Early Six Weeks, Early Triumph, Bovee, and Irish Cobbler are among the earliest. After the pieces are cut they may be sprouted in a light, warm room for a few days to hasten the growth after planting.

Before the school closes in the spring, the main crop potatoes may be planted, and if the garden is cared for by some one during the summer, the late crop may be harvested after school opens in the fall. This plan adds more interest to the school garden work. Rural New Yorker No. 2, Sir

Walter Raleigh, and Carmen No. 3, are suitable late varieties and good keepers.

Potato vines should ˙e sprayed with Bordeaux-arsenate of lead mixture as a protection from flea beetles, potato beetles, and blight.

Radish.—This crop is hardy, and may be sown both early and late. The turnip-shaped varieties are preferred to the long forms for earliest spring planting. They will form a crop in three to six weeks from sowing. The soil should be made very fine and fertilizers may be used freely. Leave the rows far enough apart to allow the use of hand tools. As some of the roots become large enough for use, thinning should begin. Any little spot in the garden that becomes available after other crops, during the season, may be used by planting radishes, except when the season is too hot. The hotbed may also be used in winter and early spring for this crop. A few grown in a window box will add interest to the school work. Radishes for late fall use may be sown in August or early September. This will add interest to the fall term garden work. They should be pulled before the ground freezes. Better use special (winter) varieties for storing. Sow these the same time as fall turnips. If stored in moist sand in a cellar, they will keep tender and crisp all winter.

Rhubarb is a perennial plant and grows so early in the spring that it is well suited to both the home and school garden. New plants may be started by dividing large clumps of roots. This is best done in the late fall, or may be done in very early spring. Plants may also be started by seed sown thinly in shallow drills a foot apart and thinned to a distance of four or five inches. This is rather too slow a process for school gardens. Rhubarb requires a very rich soil and will endure large quantities of manure. Rhubarb and other perennials should be placed at one side of the garden so they will not be disturbed by every spring preparation for annuals.

For winter forcing of rhubarb, take up strong roots in the fall, leave out to freeze, then bed them closely together on a cellar bottom. They should be kept in a rather dark situation to produce the best winter growth. Roots forced in this way may be returned to the garden, but not cropped for a year or two.

Salsify, or Vegetable Oyster.—The culture for this crop is similar to that given for parsnips, and the crop may be treated in much the same way.

Salsify is used the same as carrots. It is also boiled and then made into cakes and fried like oysters, because of the resemblance in flavor.

Spinach.—This is the greatest "greens" crop of America. The plant is hardy and may be started in earliest spring. The seed is sown in drills one foot apart and one inch deep. Successive sowings every two weeks may be made throughout the season unless the weather becomes very hot. When the school opens in September, spinach may be sown in rich garden soil. These plants may be covered with straw on the approach of severe cold weather. Some of this may even be ready for use before the ground freezes. The crop may also be forced by starting seeds in hotbeds during winter. Savoy and Victoria are popular varieties. The New Zealand type is larger and better suited to hot weather. This might be called an "evergreen" type as the plants persist and the branches are broken off for use.

Squash.—This is a hot-weather crop. The seeds are sown in the open field after the settled warm weather has started. For this reason the crop is not well suited to school garden work, but the harvesting will come in the fall after school opens. With this in mind, it is best to use late varieties such as Boston Marrow and Hubbard. Care must be taken not to let the squash vines grow too near the cucumbers and muskmelons because of the danger of the seeds becoming mixed by the crossing of pollen. The hills may be started in the same way as for those crops, but the distances may be a little greater. In localities where canning clubs are organized, the crop should be grown as it is well suited to canning.

Sweet potato is a southern crop but is grown as far north as the latitude of Philadelphia or New York. The soil should be light and well drained, and an abundance of plant-food and organic matter is desired. The plants for setting in the field are started from the seed potatoes in special beds in spring. Seed potatoes may be started in hotbeds (Fig. 113), slight heat being produced both by the manure and sun. Much care must be exercised in the management of the starting bed to maintain proper ventilation and proper temperature. As the sprouts become of proper size and the season is warm enough, transplanting begins. The largest sprouts are usually pulled first and immediately set in rows three to four feet apart, and the plants twelve to eighteen inches apart in the rows.

FIG. 113.—In selecting sweet potato plants for the garden, use those which are stocky and well rooted. (New Jersey Station.)

It is usual to set the plants in ridges raised a few inches above the general level of the field. This makes the soil warmer, stimulates the growth and insures good drainage. The soil between the ridges is kept well stirred and the vines are moved or lifted to keep them from rooting. The crop requires the entire season for growth and is usually not harvested until the first light frost touches the vine tips. After digging, the tubers are left to dry a few hours and then stored in a warm dry place. Care should be exercised in the handling so that no bruised potatoes will be put in storage.

Swiss Chard is a form of beet, but the root is small and the top is large and edible (Fig. 114). The little green wrinkled leaves have given it the name "Silver Beet." They are cooked as greens the same as spinach. The thickened mid-

Fig. 114.—Swiss chard with long white leaf-stems to be stewed and served with cream. (Cornell Reading Circle Leaflet.)

ribs are sometimes served with cream, like asparagus. The seed is drilled thinly in rows eighteen inches apart and the largest plants are first harvested, leaving the crop with the plants six or eight inches apart in the row. If the main crop is cut or pulled without injuring the crowns of the plants they will continue to produce new foliage for succession cropping. Chard may be transplanted as in the case of spinach. The crop is rather hardy and will stand some late spring frost.

This crop is becoming more popular and is usually relished by those who have grown it.

Tomato.—In early spring, tomato seeds should be started in window boxes or hotbeds and the seedlings are transplanted to the garden after all danger of frost is over. For school garden work it is well to move the plants twice. First from the seed bed they may be put in tin cans or pots and later transplanted from these to the open garden. The soil should be rich, and good drainage is preferred. The distance between rows and plants varies with the different varieties and method of training. When they are grown commercially in large areas, staking is not practiced. The average distance in such cases is three and a half feet between rows and three feet between plants in the row. Late varieties may remain for part of the crop to be harvested after the fall term of school opens. Good late varieties are Ponderosa, Livingston's Globe, and Enormous. Good early varieties for home use are Spark's Earliana and Bonny Best. Fall canning clubs can make good use of the tomato crop. Figure 115 shows the different types of tomatoes.

Turnip.—The small round varieties may be sown in very early spring in beds or drills and thinned as they become large enough for use. In late summer and early fall, turnips of any kind may be sown in beds or drilled in rows to be harvested just before the ground freezes. Turnips thrive in any good garden soil. A good practice is to sow the seed among the sweet corn at the time of its last cultivation. Such may be harvested in late fall. Turnips may be stored in a cool cellar. They may be prevented from drying too much by burying in boxes or beds of sand or soil. The best type for storing is the rutabaga, shown in figure 116.

Watermelons.—This is a hot-weather crop, well suited to the southern states and to the lighter warmer soils of the north. The culture is similar to that given for muskmelons.

They are less subject to disease and attacks by insects. The crop is not recommended for the school garden.

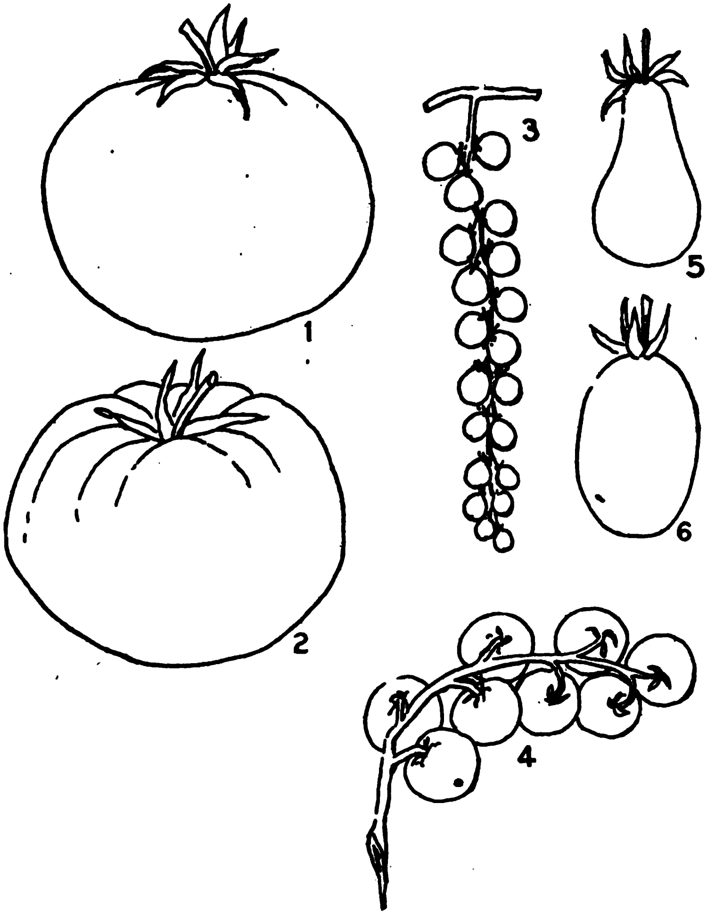


FIG. 115.—Types of tomatoes. 1. Smooth globular, shallow cavity, a good market type. 2. Ribbed, cavity deep, fruit rather flat. 3. Currant tomatoes, seldom grown. 4. Cherry tomatoes. 5, 6 Pear and plum forms of yellow preserving tomatoes.

Uses for the Garden Herbs.—Gardeners may have growing along one side of the garden a few plants of each of the following "herbs." Their special uses, as here mentioned, may be suggestive:

Mint, for meat sauces.

Angelica, for flavoring cakes.

Lavender, for oil and toilet water.

Sage, for sausage and meat dressings.

Sweet fennel, leaves used in fish sauces.

Dill, the seeds are used to flavor pickles.

Caraway, seeds used by bakers in cakes, cookies, bread, apple pie, etc.

Fig. 116.—Bloomsdale rutabagas. A form of yellow turnip that keeps well for winter use. (Cornell Station in Productive Feeding.)

Thyme, in gravies and dressings for stuffed meats.

Chives, used for flavoring soups and salads.

Borage, balm and catnip are useful where one has bees.

Tarragon, leaves useful in giving a delicious flavor to vinegar and pickles.

Coriander, fennel and caraway seeds are used for flavoring syrups and cakes.

Among the herbs having medicinal value are arnica, hops, catnip, bane, pennyroyal, belladonna, sage, rue, horehound, marshmallow, wormwood, hyssop and peppermint.

Companion Cropping.—When school or home gardens are small, and indeed in many other cases, it is advisable to grow crops of different kinds close together, or in the same row, so as one crop is taken away in the early part of the season the other kinds of crops will be already growing and will occupy the ground. This plan of growing two or more crops

Fig. 117.—Companion cropping with lettuce and cauliflower. The lettuce will be harvested before the cauliflower begins to form heads. A good combination for small gardens. (Cornell Reading Circle Leaflet.)

together, and tilling them together for the purpose of keeping the ground well occupied, is called "Companion Cropping" (Fig. 117). In some cases other advantages are attained. When radishes are planted with lettuce, the strong radish seeds break the crust and aid the weak lettuce seeds to sprout. The radishes are harvested and out of the way before the lettuce is large enough to need all the room. The radishes sprout so quickly that they mark the row so that raking the garden will not destroy the lettuce.

Salsify and parsnips are often grown in the same row, or in rows very close together for the special reason that they require the same kind of tillage, and both may be left in the ground over winter to be improved by freezing.

Examples of companion cropping are numerous. The following may be suggested: Early onions and late beets; early peas and radishes, peas with late crop of salsify or parsnips; corn and peas; corn and beans; early cabbage and celery plants; corn and pumpkins; corn and watermelons.

Succession Cropping.—The garden soil should be kept well occupied throughout the growing season. As soon as one crop is harvested, another should be planted. This plan of having one crop follow another as promptly as possible is called "Succession Cropping." The following are suggestive examples: (1) Early corn to follow early potatoes. (2) Cabbage seed or plants to follow early potatoes. (3) Egg-plants to follow early potatoes. (4) Okra to follow early potatoes. (5) Turnips to follow potatoes. (6) Turnips to follow peas. (7) Early variety of potatoes planted late after early peas, radishes or lettuce.

Soaking Garden Seed.—If the ground is ready and plans are carefully made so that the planting may be done very soon, it is safe to soak many kinds of garden seeds in advance. The benefits derived are due to the softening of seed coats and the moistening of the storage matter in the seeds.

When seeds are to be soaked care should be taken to not exclude the air from them. The dish in which the soaking is done should be left open and the quantity of water should be limited so as not to "drown" the seeds.

The water used may be luke warm and the time allowed should be only a few hours. Over night is not too long for such seeds as melons, corn, celery, parsley, carrot, and any seeds with a dry or chaffy coat. Contests have shown that seeds most liable to danger from soaking are peas, beans and sweet peas. It is safer to plant these without soaking.

Varieties of Vegetables for Garden Use

Asparagus	Palmetto, Columbia White, Colossal.
Beans, Bush	Bountiful (early), Valentine, Refugee (extra early).
Beans, Lima	Fordhook, Ford's Mammoth Podded.
Beans, Pole	Kentucky Wonder, Crease Back.
Beets	Basano (early), Crimson Globe.
Broccoli	Early White Cape.
Brussels Sprouts	Improved Half Dwarf.
Cabbage	Charleston Wakefield (early), Succession (mid-season), Late Flat Dutch.
Cauliflower	Early Snowball, Vietch's Autumn Giant.
Carrots	Half-Long Stump Rooted, Half-Long Danvers.
Celery	Golden Self Blanching (early), Giant Pascal (late).
Corn	Adam's Early Dwarf, Stowell's Evergreen (sweet), Country Gentleman (sweet).
Collards	Georgia.
Cress	Curled.
Cucumbers	Improved White Spine, Emerald, Green Prolific Pickling.
Egg-Plant	New York Purple, Black Beauty, Florida High Bush.
Endive	Green Curled.
Kale	Early Curled Siberian.
Lettuce	Big Boston (early), Improved Hanson, Wood's Early Cabbage Giant Crystal Head (late).
Mustard	Giant Southern Curled, Ostrich Plume.
Musk Melon	Extra Early Hanover, Netted Gem, Rocky Ford, Perfection Melon.
Okra	Clemson, Long White Velvet.
Onion	Yellow Globe Danvers, Prize Taker, Extra Early White Pearl, Yellow Multiplier (fall).
Peas, Garden	Philadelphia Extra Early, Horsford's Market Garden (medium), Telephone (late).

Pepper, Sweet	Chinese Giant, Ruby King.
Pepper, Hot	Long Red Cayenne.
Parsley	Moss Curled.
Parsnip	Hollow Crown.
Potatoes, Irish	Irish Cobbler, Carmen No. 3, Early Triumph.
Potatoes, Sweet	Nancy Hall, Nancymon.
Pumpkin	Kershaw.
Radish	Early White Tipped Scarlet, French Breakfast, Mammoth, Extra Early Scarlet.
Salsify	Mammoth Sandwich Island.
Spinach	Long Standing.
Squash	White Bush, Boston Marrow, Giant Summer Crookneck, Winter Hubbard.
Tomato	Earliana, Acme, Stone, Ponderosa.
Turnip	Extra Early Purple Top, Improved Red Top Globe, Seven Top (for fall greens), Yellow Aberdeen, Rutabaga.
Water Melon	Georgia Rattle Snake, Florida Favorite, Tom Watson, Kolb Gem (good shipper).

CHAPTER XVII

CORN GROWING

In the boys' club work corn has been grown more than any other crop. Corn growing contests have been organized, in schools and out of them, throughout America. The crop is a popular one in all sections, and is well suited to the work of schools.

In the fall lessons are given on the selection of corn for seed. This will require the learning of the points in a good score card. Students will learn how to judge corn accurately and rapidly. The technical matters regarding right proportion of corn to ear, purity, shape of kernels and maturity must be learned before corn can be properly selected for seed. In the fall, fairs and exhibits may be held. Methods of storing the crop and seed may also be taken up at this time of year or in early winter.

During the winter students may give considerable attention to the value of seed testing and learn different methods of testing corn by the ear methods, and by the mixture method. They can read many corn bulletins during the winter season as reading lessons in school.

In early spring methods of preparation of soil, the value of fertilizers, the importance of soil moisture and methods of retaining it are all suitable topics for study. The different methods of planting for crop of ears or total crop of stalks and ears should be taken up before planting time.

During vacation young people may produce the crop itself. They will put into practice the things which they have been studying about corn in school. The seed which was tested during the winter may be actually used in the planting. Early preparation of the soil, the use of bare fallow to kill weeds, save moisture and warm the soil will become real by actual practice.

Selection of Seed.—Skill should be attained by much practice in seed selection (Fig. 118). Take about ten ears of corn; place them side by side on a table, remove two kernels from near the center of each ear and place them opposite (Fig. 119). Use a good score card or bulletin which describes the points to be considered in good seed corn. These points are briefly given in this chapter. Judge the corn and test each ear with the best in the lot. If each student in a class has five or ten ears, let them be first judged and then exchanged for the sake of comparison. After such work has been carried on, students may be asked to bring corn from home, or select it from a pile or crib of corn for the purpose of gaining speed in selecting the best.

Score Card for Corn Judging

	Perfect score
1. Trueness to Type or Breed Characteristics	10
2. Shape of Ear	10
3. Purity of Ear. (*a*) Grain	5
(*b*) Cob	5
4. Vitality or Seed Condition	15
5. Tips	5
6. Butts	5
7. Kernels. (*a*) Uniformity	5
(*b*) Shape	10
8. Length of Ear	5
9. Circumference of Ear	5
10. (*a*) Furrows Between Rows	5
(*b*) Space Between Tips of Kernels at Cob	5
11. Proportion of Corn to Cob	10
Total Points	100

Explanation of Points.—1. The ears in a sample should be alike, or nearly so. They should agree with the type of corn which the lot represents. Type is somewhat determined by the number of rows on the cob, width and shape of crowns of kernels, shade or color and shape of kernels, as seen when removed from the cob.

2. The ears should be nearly cylindrical in shape, tapering

only slightly towards the tip. If the tapered portion is too long, there will be many small kernels at that end, the effect being to reduce yield and form nubbins in the next generation.

3. (*a*) Purity of corn is indicated by uniformity in shape and color. Variation in color indicates impurity, which may mean wide variation in other respects in the next crop.

FIG. 118.—In preparing corn for an exhibit careful selection is important. (Agriculture and Life.)

(*b*) Yellow corn should have red cobs. White corn should always have white cobs, except in a few varieties of so-called white corn which may have pink or red cobs. "White Capped Yellow Dent," for example, may be called white corn, and some strains of it have pink cobs.

4. Vitality is one of the most important features considered in selecting all seed corn. The kernels should fit each other closely from all sides. Looseness indicates lack of maturity. When kernels are shelled, the chaff should remain on the cob and not cling to the kernels. The outer tip coat should cling to the kernels and not remain on the cob. When black tips are found on the kernels, low vitality is indicated. Shrunken, blistered or starchy crowns are bad indications. The broad, wedge-shaped kernels give room for large germs. The size of the germ may be determined by surface view of the kernel, and by making sections lengthwise and crosswise.

5. The tips of the ears should be well covered with corn

without protruding cob. The rows should run over the tips somewhat regularly and the kernels conform closely to those in the main body of the ear.

6. The butts should be so well covered with corn as to leave a deep depression after the shank or stem is removed. The stem itself should be very slender, which would allow the ears to droop over as soon as they are nearly mature in the field. This helps to prevent damage from rain.

7. (*a*) Uniformity of kernels is important when planting time comes. It also increases the amount of corn on the cob. Kernels of irregular size and shape are shown in the interrupted rows. These do not drop evenly in the planter and may often cause more open spaces on the cob.

FIG. 119.—Students should prepare corn boards for use when judging corn. Ten-ear samples may be exhibited on such boards. (Agriculture and Life.)

(*b*) The shape of kernels is quite variable but they should be deep and wedge-shaped with rather straight sides, allowing the rows to fit each other closely, filling all spaces on the cob. The type of the kernel should be broad, as this is rich in protein and oil, and of high feeding value.

8. The length of ear varies with varieties and sections of the country. Ears with good tips, but short length, should not be selected in preference to ears of good length having less perfect tips. When ears are too short, future yields are likely to be reduced. In any sample the length should be uniform. A good type of length should be fixed in mind when selecting seed corn in the field, and ears of this length should be constantly sought. The objection to very long ears is their tendency to have poor butts and tips broad, shallow kernels and a low percentage of corn to cob.

9. Well-shaped ears have a circumference about three-

quarters of the length. This proportion, however, varies with varieties. Very large ears are usually slow in maturing, and may produce soft corn. In some cases large ears are the result of very large cobs. This will diminish the yield of shelled corn. The circumference of an ear is usually measured at one-third the distance from the butt to the tip.

10. (*a*) Furrows between rows will be very slight if the kernels are of proper shape. If these furrows be large, the proportion of corn to cob is much reduced. If the ears in a sample of seed corn vary greatly in this respect the type will not be uniform.

(*b*) The spaces between tips of kernels at the cob will tend to make the kernels loose so that they move when pressed by the hand. This usually means poor seed corn and low feeding value. If the tips are well filled, they will be tight on the cob.

11. The proportion of corn to ear governs very largely the yield of shelled corn per acre. Breaking several ears will show wide variation in the size of cobs and the depth of kernels on them. Deep kernels and small cobs indicate large proportion. The shape of kernels and spaces between rows also affect the proportion of shelled corn. In judging contests and exhibits the proportion of corn to ear should be determined by weight. Delicate spring scales may be used. Shell the corn from a sample ear into a paper bag. Weigh the corn and cob together. Then weigh the corn without the cob. Divide the weight of the shelled corn by the total weight of the ear. This will give the per cent of corn. The per cent should be as high as 85, but frequently runs higher than this.

When to Select Seed.—Seed corn should be selected in the fall before the crop is harvested. Then the most mature ears may be easily found by the color of husks and drooping of ears. A boy may hang a sack on his shoulder and go over the field selecting such ears as may prove to be satisfactory on closer examination. These should be carefully dried. Later on they may be judged more carefully and stored for next season's planting.

Storage of Seed Corn.—Corn intended for use as seed should be well dried before freezing weather. Freezing after it is thoroughly dry is not detrimental. Storage should be in a dry place, as moisture is very harmful and reduces the germinating power. Attacks of mice, rats and sparrows must be avoided. In southern climates grain moths may attack the corn and weevils may do much damage. Precautions must be taken to keep these enemies away.

Seed corn racks are easily made, using wire or strips of cloth on which to lay the corn so that air may circulate about the ears.

A simple method of storing seed corn is to drive nails in lines along the sides of a pole suspended from a roof or ceiling. The butts of the ears are slipped over the headless nails. Wire or wood lath may be nailed in the joists of the floor in any dry building or shed. Corn is laid in single layers on the wires. Ears of corn may be woven in double strands of binders' twine and suspended in long strings from hooks on the ceiling.

Testing Seed Corn.—Benefits of testing seed of any kind may be enumerated as follows: (1) Better stand in the field is secured if the seed proves to be good. (2) Re-planting is made unnecessary. (3) Time is not lost in watching for poor seed to sprout. (4) Labor is saved by not handling and planting poor seed. (5) Seed is saved, as poor seed could be used for feed and not lost in the planting. (6) The purchase of poor seed may be avoided by testing samples before buying. (7) More uniform yields are secured at harvest time.

Methods of Testing.—The best plan is to test each ear separately instead of shelling all the seed corn together and testing a sample of the lot. If each ear is tested, any which show poor germination may be culled out and used for feed; thus several hundred kernels of low germination may be removed at once. Several good plans are devised for using individual ears of corn. They are as simple and rapid as the composite method of testing seed corn.

Box Method.—First wet the sawdust in a shallow box. On this spread a white cloth which has been marked off into squares about 2 in. × 2 in. The squares should be numbered from left to right so as to read in order of lines on a printed page. The ears of corn to be tested are numbered with small squares of paper fastened to each ear by means of a slender nail thrust through the paper into the butt of the cob. Five or ten kernels are taken from different parts of the first ear, avoiding the butts and tips. These kernels are placed on square numbered one; and so for each of the other ears. After the squares are all covered, place a cloth or wet paper over them and cover this with an inch or more of wet sawdust. Allow this to remain in a warm room for ten days or so. The results may be seen by raising the top layer and comparing the germination power of the different ears (Fig. 120). Any ears which show low vitality by failure to germinate or weakness of germs should be discarded and used for feed instead of for seed.

Rag Doll Method.—This method of testing seed corn is the simplest and easiest of all. It is used for testing a sample of each ear of seed corn. Secure muslin or sheeting and tear into strips ten inches wide and several feet long. Ravelings on the edge may be carefully drawn away or the edges may be hemmed. The cloth should be marked with a black pencil lengthwise in the middle and then with cross marks about three inches apart. Number all the squares, beginning at one end of the cloth; numbers one and two are side by side at one end. The odd numbers will then be down the left column and the even numbers down the right column. Wet the cloth, wring it well, and spread it on a table or smooth board. Remove either five or ten kernels from ear number one and place them on square number one. Take a like number from ear number two and place upon square number two continuing until all the squares are covered, and then use other cloths for the remainder of the ears. The ears are numbered as described by testing with the box method.

When each square of the cloth has been supplied with its kernels begin at upper end with numbers one and two and

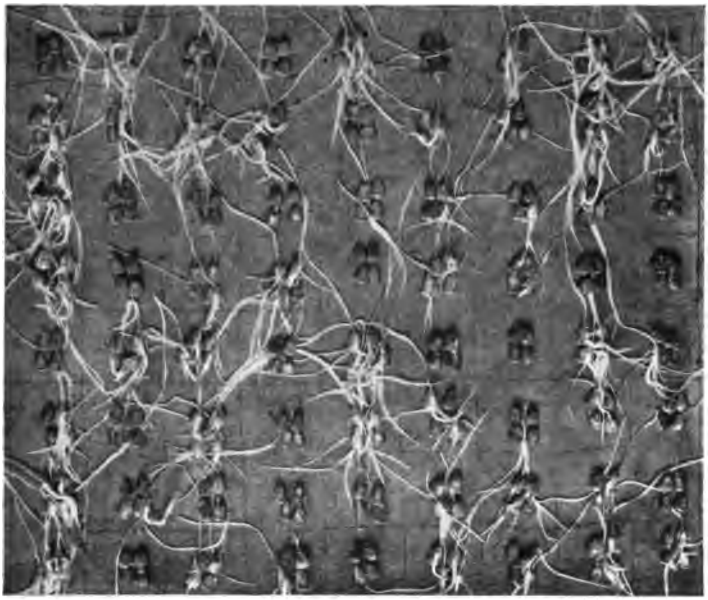


FIG. 120.—Result of a germination test of 72 ears of corn showing weak and strong kernels from the different ears.

roll the cloth up. A common pencil or long piece of wood may be placed in the center as a core. When the cloth is all rolled up tie it loosely with string. Each roll should be numbered or lettered and the date placed on a paper under the string. These "rag dolls" may now be soaked in water for a few hours, then remove them and place them on strips of wood to drain, and cover with a box or vessel, which will prevent the cloths from drying out. A very few drops of formalin in the water will prevent molding. These are kept in a warm room for a week or two and may be examined when desired. Squares which contain kernels with weak germs are the ones to be discarded.

The Iowa station gives the following advantages of the "Rag Doll" method:

1. The cheapest tester which can be made.
2. Anyone can make the tester in a few moments' time.
3. The least trouble to prepare and fill of any tester made.
4. Corn may be placed in the tester and the test read approximately as quickly as any other tester which can either be made at home or purchased.
5. If saturated atmosphere with moist cloth contact is desired, this may be secured by leaving the rolls in the water only long enough to become thoroughly moistened.
6. Less mold develops in this tester than any other.
7. May be disinfected for mold most easily.
8. Very compact, and can be moved from one place to another without difficulty.
9. All parts of kernel, roots, shoots, etc., can be readily seen.
10. Gives an accurate test as indicated by field results.

Corn Improvement.—Those who are giving attention to the subject of corn breeding are accomplishing a great deal in the improvement of this great standard crop of America. The chief methods involved in the improvement of the corn are: (1) Selection of good seed. (2) Detasseling of puny or unpromising stalks. (3) Enforcing cross pollinating by detasseling alternate rows. (4) The use of the ear-row method of growing and testing production.

The points in selecting good ears have already been described in this chapter.

De-tasseling Poor Stalks.—Young people should understand that the pollen of corn comes from the tassels on the top of the stalks (Fig. 121). When the pollen is scattered by wind to the silk of the ears a growth follows which finally produces the kernels on the cob. The spreading of pollen to the silks is called pollinating. With plants, as with animals, it is important that both parents of the offspring should be healthy, vigorous, and possess the best points of their kind. If weak stalks, which do not bear good ears, are used as one of the parents of either seed corn or market corn, the results will be less satisfactory than if both parents were strong individuals.

FIG. 121.—Corn silks must receive the fine pollen dust from tassels of other stalks before corn will form well. In this case little such pollen was received. (U. S. D. A.)

It is good practice to go over the corn-field, where seed corn is to be produced and cut the tassels from all stalks which are not promising. This should be done before the tassels are mature and before any pollen has scattered through the field. Much difference between stalks can be noticed at that time. Some will be strong and healthy in appearance and have the rudiments of good ears upon them. The tassels on such may be left.

The de-tasseling of puny stalks is done on the westerly side or the windward side of large fields, and in that part of the field the seed corn is selected the following fall.

De-tasseling of Alternate Rows.—When pollen scatters from the tassels of corn it may fall either upon silks of the same stalks or upon silks of other stalks. The latter is called cross-pollinating. Experiments have shown that cross-pollinating produces better corn. To compel or enforce cross-pollinating of seed corn, the usual plan is to de-tassel every second row on the westerly side or windward side of the field, or throughout the field. The seed corn is then selected only from the rows having no tassels. Such rows will have received their pollen from other stalks and are said to have been cross-pollinated.

A combination of these two plans of corn improvement is accomplished by de-tasseling alternate rows, and in addition to this de-tasseling the stalks which are not promising in the other rows.

How to De-tassel Corn.—As already stated, the removal of tassels must take place before the pollen is scattered. The field must be watched closely for a few days at the right time. A large butcher knife or a light corn knife is used to cut the tops. This may be done by a single quick stroke just below the tassel portion. It is not necessary to save these immature tassels. They will fall to the ground and the pollen will do no harm. De-tasseling does not affect the value of the fodder in the future crop.

The Ear-row Method.—One of the best ways of improving seed corn is to first select the best ears from good stalks in the field. These ears are used the next season in separate rows or portions of rows. For example, kernels of ear number one are planted in row number one. Kernels of ear number two are planted in row number two. This plan is continued with as many rows as desired. The yield of each row is carefully measured or weighed the following fall. All future seed corn is saved only from the heavy yielding rows. The best ears are selected and planted again by this method.

Danger of Mixing.—As the pollen of corn is carried by wind for some distance there is danger in planting two varieties too near each other. Any pure, well-selected corn should be grown separately to avoid crossing. When corn has once become pure or well fixed in character by methods of selection and good breeding, it is very bad policy to allow any crossing of varieties of strains to take place. Such a practice immediately sets up variations in the product which make it impossible for the corn breeder to know what to expect. Sweet corn must not be grown near field corn, for the same reasons (Fig. 122).

Fig. 122.—Country Gentleman is one of the best varieties of sweet corn, medium in season. (Pedigreed Seed Co., Hartsville, South Carolina.)

RAISING THE CROP

In the corn club work in most of the states the plots used in the contests do not exceed one acre. As small a plot as one-tenth acre has been specified in some contests. One-quarter and one-half acre plots are frequently used. The size of plot should be governed somewhat by the age of young people admitted to the corn clubs. The first plowing of the ground is usually done by some older person, but the harrowing, planting, cultivation, choice and testing of seed must all be done by the contestant.

Preparation of Soil.—If possible the ground for corn crops should be plowed very early. If plowing is done several weeks before planting time, the soil may be worked as deep as the good soil extends.

Harrowing should immediately follow the early spring plowing. It should continue at intervals until planting time. Never allow the ground to become hard or packed as the result of heavy rains. Almost as soon as the free water is soaked in, the next harrowing may take place. The effects of frequent harrowing during the time between plowing and planting are: (1) Sprouting and killing of numerous weed seeds and the avoiding of a weedy field through the summer. (2) The warming and airing of the soil so the seed corn will sprout more promptly. (3) It prevents evaporation of water by the formation of dust mulch. (4) It allows surplus water to percolate or move downward in the soil for the future use of the crop in dry weather. (5) It multiplies bacteria in the soil, which, in turn, unlock plant-food for the growth of the corn crop.

Planting the Crop.—The depth for planting corn varies with the condition and character of the soil. In medium soil, which is not too dry, about two or three inches is usual. The kernels should not all be dropped in one place if the hill method is practiced. The kernels should be an inch or more apart in the hill.

Whether to use the hill method or the drill method will depend upon the objects in view in the production of the crop. If ears and not fodder are wanted, the hill method gives best results. The corn is then planted in rows each way and cultivation may take place both lengthwise and crosswise of the field. This plan is sometimes practiced to aid in the fighting of weeds. By the drill method is meant the planting of corn in rows so that a single stalk stands in a place; these may be ten to twenty inches apart. By this planting the maximum amount of feed may be raised on an acre if stalks and ears are both to be used.

Tillage.—As soon as the corn is planted the field should be harrowed. After the corn is up about two inches, harrowing may again be done. For this purpose a common spike-toothed harrow, with the teeth set sloping slightly backward, may be used. A light weeder without wheels is very suitable. Harrowing on a corn-field, after the plants are up, should be done at a time of day when there is little moisture in the plants. In very early morning many of the tender plants may be snapped off by the harrow teeth. Afternoon is better. On fields which have been harrowed well before planting there is practically no danger from the harrowing after the plants are up. If the field is covered with large stones, this form of cultivation may cover some of the corn. On smooth fields, young people should never be afraid of doing any damage to the growing corn by the use of a harrow for the first few weeks of its growth. This method of tillage is more rapid than with a common cultivator. It places moisture better. It tills the soil closer to the plants and breaks the sprouts of many more young weeds beneath the surface of the soil.

After corn is large enough to be broken down by the cross-bars of the harrow or weeder, this method should be stopped. The cultivator may be used the balance of the season. Fine-toothed cultivators are best. Broad shovels are not desirable. Level culture usually gives better results than the "hilling up" method. Corn roots are very shallow and should not be disturbed by a deep cultivation. Thorough preparation of the ground before the corn is planted will make it unnecessary to cultivate the corn-field very deep while the corn is growing. Frequent cultivation will largely take the place of deep cultivation, as it prevents the formation of a crust at the top of the soil.

Harvesting and Storing.—Suggestions have already been given regarding the time and method for selecting seed corn in the field. After the seed has been harvested the main crop should be cared for and this should be done before any severe frost occurs. Corn is much injured by heavy frost. The most economical method of harvesting corn is to cut the stalks either by hand, knives or machine and place them in shocks of suitable size to allow of proper curing. In southern climates there may be a large supply of moisture in the stalks at harvest time and the shocks should be small and open to the air. This will aid in the curing and help to prevent molding. After corn is cured in the shocks, the ears are husked. These are allowed to dry for a few days in a suitable place and then placed in cribs. For other methods of harvesting and methods of curing seed corn, reference is here made to U. S. Farmers' Bulletin 313 and to "Productive Farming."

FIG. 123.—An Arkansas corn-club boy who won prizes in county and state contests. His yield was 85 bushels per acre in a bad year. (O. B. Martin.)

Corn for Contests.—When corn is to be weighed or measured in contests where the yield is involved, a uniform plan in a club should be adopted in advance. It is well to have the weighing or measuring all done after the ears are dry enough to be in crib without any danger of molding. The rules of some clubs require that the yield shall be determined several weeks after this time (Fig. 123).

CHAPTER XVIII

GARDEN CALENDAR FOR NORTHERN STATES

ANY person familiar with garden methods will know about the right time to plant each of the garden crops. The exact time for planting varies from year to year, and varies greatly in different latitudes and climates. It is impossible, therefore, to give any calendar for planting, or other garden operations which can be followed absolutely. A calendar of this kind should be merely suggestive to young people, teachers, and others who have their attention much of the time on other matters. Such a calendar may be referred to occasionally and will be helpful in suggesting about the proper time for different garden operations.

JANUARY

Vegetables.—Begin planning the garden by choosing varieties, and ordering seed.

If plants of various kinds are in coldframes, they should be cared for on warm sunny days; a little ventilation is then necessary. Give the plants all the air and light possible without allowing them to be chilled too badly. If water is standing in the frames, be sure that it is drained away. In coldest weather the sashes should be well covered with straw mats, or other material, and the frames well surrounded with a bank of manure.

Preparations may be made for the starting of hotbeds. Manure to be used in hotbeds in winter should be stored where it will not freeze. A box stall, where a horse is kept, is a good place to allow it to accumulate for this purpose. Hotbed sash should be glazed and put in repair. If the frames for the beds are not ready they should be made this month.

Wood ashes should be saved under shelter for use in the garden next spring. Coal ashes may be used on heavy clay soils just to lighten the texture.

Examine the garden tools and implements to see that they are not rusting. The metal parts should be covered with oil or wagon grease to prevent rust.

Trees and Fruits.—Trees about the school and home grounds should be pruned. Do this on days when the weather is favorable. Grape vines, peach trees, gooseberries and currants are to be pruned early. If only a little pruning is to be done, apple and perhaps other fruit trees may be left until nearly spring.

Plans for spraying should be made soon. Never try to spray during freezing weather. Warm days may be chosen, either this month or soon after the pruning is done.

Make collections of winter shrubs and trees in winter condition for the sake of knowing all the varieties. These are also useful in school work.

Strawberry beds and other parts of the garden which were mulched in the fall should be examined now, if there is no snow. If the mulching materials have blown off replace them and prevent further trouble by weighting with boards or brush.

Flowers.—Get collections of flower seeds. If there are old ones, test them to be sure of their powers of germination. Send for garden catalogues and decide on what annuals and perennials you desire to plant.

Keep the window boxes well supplied with growing plants. Leaf and green wood cuttings may be made of house plants. If any bulbs are started in the cellar some of them may be brought up at this time and placed in the windows.

FEBRUARY

Vegetables.—Spread manure in the garden when the ground is free from snow. Test all old vegetable seeds on hand. Make up your spring orders for the varieties which do not germinate well, and for any others you do not have.

If coldframes or hotbeds are not finished, they should be completed now. You will need them soon. The smaller the garden, the more need there is for frames. Manure for hotbeds should be fresh from a horse stable. Do not use the drier parts of the litter. Use the lighter parts to bank around the frames to keep out the cold. Use about one foot of manure after it is well tramped down. Six inches of rich soil on top is usually enough for most crops.

In the hotbed start seeds of cabbage, cauliflower, lettuce, beets, carrots, parsley, onions, spinach and any others which you will want early. Radishes may be grown between the rows or in the rows with others.

Young people living in homes where there are suitable cellars may start mushroom beds in the early part of February.

Rhubarb may be forced during the entire winter. If roots were dug for this purpose in the fall, place them in a warm part of the cellar and water them well. Much light is not wanted. Long heavy stems, with small leaves, are produced in partial light. If the roots are planted in boxes of soil in the cellar, the moisture is retained better.

Asparagus and rhubarb beds in the garden should be given a heavy application of well-rotted manure. Rhubarb may be forced in the garden by placing a box over a few plants and covering the box entirely with a pile of heating horse manure.

Trees and Fruits.—Finish any pruning which has not already been completed. Young trees set the preceding fall should be given special attention. Do not let the pruning of grape vines and bush fruits be neglected too long. This is probably the best month for the spraying of shrubs and trees to combat the scale insects. If the ground becomes soft, examine the ground near the base of the trees, and see that no openings near the trees have been made. Press the soil firmly about the trunk of each tree. This will prevent drying out as spring approaches.

Flowers.—Many hardy annual flowers may be started this month by sowing seed in hotbeds and window boxes. Also start some that are less hardy, such as castor bean, cobea, dahlia seeds, pansy (Fig. 124), gaillardia, canna, and China aster.

A few kinds of flowers that have been stored in the coldframe through the cold weather may be lifted out on some mild day and brought to a warm room or hotbed to encourage growth and blossoms. Hardy pansy plants should be tried in this way. These should not be made too warm, but give them plenty of light.

FIG. 124.—Pansies may be started into bloom in the hot bed, or coldframe and set in the open garden in early spring. (U. S. D. A.)

MARCH

Vegetables.—March is more influenced by the season than almost any other month of the year. There may be a number of warm days for garden work. On such days let the garden be prepared as rapidly as possible. It pays to dig up the ground or to plow early. All neglected work of January and February must be rushed to completion.

After the ground is spaded or plowed, thoroughly rake or harrow it. Never allow lumps to show on top from now on.

Get the bed or portion of the garden into the condition which you want it. Add well-rotted manure in abundance where needed, probably everywhere. Drain wet places, if this was not done the preceding fall. Add lime and wood ashes to any low, heavy soils. Sand may be brought in for use in places where nursery seedlings are to be started. A sandy bed is available for many special purposes.

Additional sowings of lettuce, cabbage, cauliflower, radishes and perhaps peppers, egg-plants and tomatoes may be made in the hotbed.

The hotbeds need more attention this month because of the variations in weather. Watch the ventilation more carefully. Early plantings must be thinned and transplanted. Give them plenty of room. Toward the end of the month some hardening for a few kinds may be advisable.

Out-doors it is well to make an early start with early potatoes, lettuce, radishes, peas, beets, onion sets, spinach and others. These may be put in at a risk, but if they get through the late cold snaps, you are that much ahead.

The windows should be full this month with the transplanted things. Use all available berry baskets, tin cans, wooden boxes and pasteboard boxes from the grocery. A little crowding of the space this month will be relieved later.

This is the best time to plant perennial vegetables. Be sure to set out asparagus and rhubarb roots.

Trees, Fruits and Lawn.—Early this month is the last chance to prune dormant trees and shrubs. Have all planting of new trees or shrubs completed in March, if possible. Do not wait for Arbor Day, if it is set too late. At least have all plans well laid and the things to be planted heeled-in where they will take no harm.

The lawns should be put in good shape. Roll the sod to press down the roots and crowns well.

Clear off all prunings and make the surface ready for mowing later.

This is the best time to sow grass seed on the bare spots of the lawn. Spade around the fruit trees and perhaps a small circle around the shade trees bordering on street or road.

Look over the tops of plum and peach trees to see if there are any "mummied" fruits. These should be removed and burned or buried. They carry spores which would infest the next crop.

Flowers.—Transplant some ferns from the woods to the north or east side of the house. Have the soil very rich by adding well-rotted manure and leaf mold from the woods. A cool place sheltered from the sun is necessary. Look for roots and plants of wild perennial flowers. Transplant them from the woods and fields to a place in the garden which we will call the "wild border." Collect many anemones, dog-tooth violet, wake robin, mandrake, blood root, and others you can find.

Bulbs, such as tulips, narcissus, and others that have been forced in the house or hotbed may now be put in the garden. Some of them may bloom again later this season or early next spring.

Early this month the bulbs set last fall should be coming through. Look over the beds carefully and see that conditions are favorable. The mulch may be partly removed, if it is coarse or lumpy.

The hardiest annual flowers may be sown out of doors this month.

APRIL

Vegetables.—Complete any plowing and other preliminary work for the garden. Rake or harrow all the beds several times until the plants are sprouted. It pays to keep the whole garden in the form of a fine seed bed throughout the month to save moisture, sprout weed seeds and warm the soil.

Make the largest plantings of peas, lettuce (Fig. 125), spinach, early cabbage, kale, cauliflower, radish, turnip, beets, salsify, carrots, parsnips, onions and early potatoes. Late in the month try a few of the more tender vegetables such as lima beans, sn: p beans, okra and others.

Transplant to the garden a few of the strongest vegetable plants from the window boxes or hotbeds. If the ground stops freezing at night, well-hardened plants, such as cabbage, let-

Fig. 125.—Boston head lettuce. Section showing solid texture and light color which help make the finest quality. (Cornell Reading Circle Leaflet.)

tuce, cauliflower, kale, spinach, turnips and beets, may be thus moved out-of-doors.

In the hotbed plant seeds of melons, cucumbers and squash in berry boxes or pieces of sod, which will be later transplanted with little disturbance of the roots to the open ground.

Trees, Fruits and Lawn.—Complete all planting of fruit and shade trees early in the month. Take no risk after the leaves have started. This is probably the best month for transplanting evergreens. Be careful to not let the soil fall from the roots. Move large balls of earth with each. A little well-rotted manure should be placed around all shade and fruit trees, and along the rows of currants and gooseberries after digging up the soil. Do not forget the planting of perennial vines and roses.

The lawn must be cared for well. Rake all bare spots and scratch in fresh seed. A little well-rotted manure or black soil on these spots will help.

Fertilize the whole lawn by spreading fine lime, phosphate and perhaps some nitrate of soda.

Flowers.—A hardy flower border should be given much attention now. Divide the large clumps of goldenglow, perennial phlox, larkspur, monk's-hood, and others. Do not let them become too crowded. Trim out dead tops of all perennial herbs and give the place a general cleaning up. Spade over the bare spots between clumps. Fresh black soil should be added to the lowest places to give all a smooth even surface.

Begin the hardening of the potted house plants by placing them outside on warm days of April, preparing them for plunging in the garden later. More plantings of the hardy flowers may be made out-of-doors. Plant pansies, sweet peas, and gladiolus seed in the early part of April.

MAY

Vegetables.—After all danger of frost is over the main plantings of tender vegetables may be made out-of-doors—beans, cucumbers, melons, squash, sweet potatoes, peppers and egg-plant.

Second plantings may be made for the purpose of a succession of beets, peas, onions, lettuce and radish. Cabbage and cauliflower started in the frames may be transplanted. Late in the month tomatoes may also be transplanted to the open garden.

Egg-plant, okra, peppers and tomatoes are the tenderest of garden plants for the North, and should not be touched by frost in the spring. Put them out about ten days later than corn planting time.

Asparagus and rhubarb may be grown well during this month. A little nitrate of soda early in the month will stimulate the growth. Liquid manure may also be used, particularly at dry times.

Sweet corn of one or two choice varieties should be planted at several different times to give a succession of ears throughout the season.

Sow late cabbage, kale, turnip, celery, parsnip, and plant late potatoes during the latter part of the month.

Plan carefully on the succession of crops for each spot in the garden. Have plants ready to set where early crops are taken off. Never leave a bare place in the garden. The best gardeners keep something growing in every spot all the time. Even the hotbeds and coldframes can be made use of until June in getting plants ready to transplant to the open garden. Thus the bare places can be filled easily. May is a month when cut-worms are very bad. After weeds and other plants are more common they do not hurt the vegetables so much. Mix bran with Paris green—one quart to one teaspoonful. After wetting to make it in paste form, spread it around the newly set plants in the parts of the garden where the cut-worms are bad. The worms should be destroyed with this. Be careful to not poison poultry or birds. Cut-worms may be dug out with the finger, or hand weeder, and then killed. Kerosene emulsion should be used upon any plants where plant lice are troublesome.

Trees, Fruits and Lawns.—Strawberry plants should be set early this month, if not in April. Where spring planting is practiced, it should be done the very first day the ground is dry enough to work. As the new plants begin to grow, pick off all blossoms, as they take the strength from the growing parts.

The old strawberry bed to bear berries this year should be given close attention. If no mulch was applied the preceding fall, cultivate the soil early this month and apply a good mulch of marsh hay, clean straw or other fresh litter. Place the mulch close around the plants and let it fill all the spaces between. It will help to keep the berries clean, prevent the loss of soil moisture, and keep down the weeds until after the berry picking is over.

Watch for the falling of petals on any fruit trees. This is the best time to spray for codling-moth and plum curculio (see Chapter XX).

After leaves have formed on trees and bushes many dead parts may be discovered. Trim these out so that all that remains will have a live green appearance.

Spring flowering shrubs, such as forsythia, syringa, lilac and others, should be pruned as soon as the blossoming season is over. Cut back the twigs and also remove the oldest stems entirely. This will make them better bloomers next year.

Do not neglect to mow the lawn early and often from now on. Lawn-mowers should be used, if possible, as their rollers help the sod.

Flowers.—Finish the transplanting of any perennial herbs this month. Do not move such plants after they have made a vigorous growth of new roots. If the plants are transplanted to well-drained soil, water them freely to stimulate the growth.

Bulbs that have bloomed in the early spring may be either left in the grounud or dug up to make way for other plants. If dug up, they should ripen or dry well, and then be stored for next winter and spring.

Put the potted house plants out-doors late in the month, or after danger of frost is over. If they have been hardened off, as suggested last month, they are less likely to suffer on cool May nights. The pots or cans in which they are growing may be plunged in the garden soil in an out-of-the-way place for the summer. Thus they are ready to be taken up and re-potted next fall.

The window boxes in the school-room and home may be now supplied with new seedlings of both annuals and perennials, and with root slips of geranium, chrysanthemum, carnation, coleus and others.

Carnation and rooted chrysanthemum may be moved to the garden late in the month. Such tender plants as dolichos, nasturtium, salvia, canna and calladium may be put out-of-doors after all danger of frost is over, or if the weather is warm. They may be protected if still, frosty nights occur.

JUNE

Vegetables.—Tender vegetables may now be put in the open garden without danger of frost. Even the hot-weather plants, such as cucumber, melons, pumpkins, and squashes, should be started or transplanted from their places in the hotbed.

The latest plantings of early garden vegetables may be made in June for the sake of bringing late crops. This is perhaps the best time for starting late cabbage or fall crop of cauliflower except in the extreme northern sections where the crop may be started in May or in April. Sow the seeds in the open garden.

Have the field very clean of weeds, and if the seed is planted in hills, throw a spoonful of lime near each hill. This marks the hills and makes it easier to keep the rows free from weeds. Transplant celery to the garden rows any time this month.

The early tomato plants should be trained to stakes or trellis. Bushy plants may have three stakes placed in a triangle about them. Tie up the branches with soft cord or raffia. Tying up the plants makes the fruits ripen earlier.

Prevent blight on tomatoes and potatoes by spraying with Bordeaux mixture this month. Paris green mixed with Bordeaux will combat the potato beetles and the tomato worms.

The vine plants are likely to be attacked by squash bugs and striped beetles. Follow directions given elsewhere for fighting beetles. Vine borers attack squash and pumpkin vines. Cover the joints of the vines with fresh soil all around the main plants. The vines will take root and not suffer so badly from the borers.

Early plantings of peas and beans, if of the climbing sorts, should be kept up on their poles or other supports. All late plantings of lettuce, radishes, peas, carrots and beets should be made in the coolest soil, or coolest spots. These are cool weather plants and may suffer from summer heat.

Keep the garden well cultivated. Use the rake or wheel hoe frequently.

Rhubarb and asparagus should not be harvested after this month. Give these plants a chance to gather strength for the next year's crop. A heavy application of fresh manure about the plants will pay well.

School gardens which are not to be cared for during the summer vacation must be put in readiness before school closes. A good plan is to sow cowpeas or soybeans among all the vegetables and let them occupy the ground to keep down weeds. These will gather nitrogen from the air and improve the soil. Before this is done the whole garden may be harrowed over, if most of the early crops are harvested. Portions of the garden containing the fall crops may be put in condition and left undisturbed until school opens in the fall. A little cultivation and attention during the summer should be given.

Trees, Fruits and Lawns.—Late this month plow up the old bed of strawberries that has borne for two seasons. These plants have passed their usefulness and the ground can be used for late summer crops. A green manure crop may be grown, if nothing else. It may be well to use some of the strongest plants to set runners for August planting. This may be done by placing three-inch pots or cans in the ground near the plants and rooting the runners in the potted soil.

If the rooting of runners is started early in June the plants may be ready for setting in a new bed in August or September.

If you are growing the young beds of strawberries by the hedge-row system, be sure to keep the runners cut off. No runners should be allowed to start outside of the rows. They take away the strength of the main plants and reduce the fruit crop. Larger berries and better yields are secured by keeping the runners cut. Large heavy crowns, with many fruit stems and blossom clusters, will start up from the main plants. Gardeners producing the best strawberries do not let runners form a matted bed. After the bearing strawberries have yielded their crop, mow down the plants, rake them off and remove them to the compost heap. This reduces the danger from leaf spot, diseases and insect enemies. Then cultivate the bed well.

Spray the currants with Paris green to keep off the worms until the fruit sets.

Watch for any insect attacks on the ornamental shrubs and shade trees. If the enemy is eating the leaves, use Paris green or arsenate of lead as a spray.

For combating lice on snowball, hydrangea, or other shrubs, use kerosene emulsion.

Fruit trees should be given another spraying with Bordeaux mixture and Paris green two or three weeks after the fruit has set. The summer strength of lime-sulfur may take the place of Bordeaux on apples.

If the weather is not too dry the lawns should be mowed frequently. Proper attention must be given to details for the best appearing lawns. In poor spots a little extra dressing of nitrate of soda, or sprinkling with liquid manure, will stimulate the growth of grass.

Flowers.—Stake the tallest flowering plants. Do not let them be broken by wind. Look out for larkspur, dahlia, cosmos, lilies, gladiolus, monk's-hood, tall anemone and others.

Many kinds of perennial flowers may be planted from seed this month. It is late, but many of them will be ready for blossoming next season.

Transplant any annuals you have left in the frames or windows. Fill in bare spots of the perennial border with annuals, if you have no others.

Set fringing borders of coleus and other bedding plants. If any strong flowering bulbs are still in the ground, dig them up and let they dry well, and store in a dry place till fall. Leave the summer bulbs, such as crocus, dewdrops and others, in the soil to blossom year after year.

JULY

Vegetables.—Keep down weeds and conserve moisture by frequent surface tillage.

Insect pests must be kept off, especially those affecting melons and squashes. Among the vegetables that may be planted profitably for succession in July are wax beans, sweet corn and beets. Use early varieties for each of these. They mature much quicker and will be through earlier. Corn and beans must mature their crops before frost.

If dry weather comes on, irrigate or water the plants abundantly. If hand sprinkling is necessary, better take the nozzle off. Pour the water on in floods rather than in fine drops. It is the soil that should be wet and not the plants themselves. When the ground is well soaked, the roots follow the moisture into the ground. If only the top is moist the roots are kept at the surface and will suffer worse from drought. A thorough soaking once or twice a week is better than a light sprinkling every day.

Trees, Fruits and Lawns.—Prune back the heads of the young blackberry canes. Three feet is high enough. Long branching laterals are also objectionable. Make the plants bushy and compact.

It is possible to delay the ripening of currants by shading a few bushes with burlap before the fruits are full grown. This gives a longer ripening period.

Prune back the canes of black cap raspberries to thirty inches or less in height. This causes branching and gives more fruit next year.

Young fruit trees, such as peaches, plums, apples and pears, should be examined this month for summer pruning. Remove with the fingers the little shoots on the main branches and base of the lower limbs. Where the growth is taking place in undesired parts remove the shoots with the fingers. This forces the growth the remainder of season where it is wanted.

Peaches, plums and pears which are bearing fruit should be examined to see if the fruits are too close. Thinning fruits in late June or early July increases the size of the remainder. Never allow the fruits to touch each other. With peaches and plums the distance apart should be four to six inches.

Summer pruning of shade trees and shrubs is also a good practice. Better results are thus secured with less effort.

Flood the lawn at night, if the weather is dry. Let the water soak in deep.

Flowers.—The soil in all flower beds should be loosened with a rake or hoe. Never allow it to become hard and crusty.

Again look out for the tall flowers. Stake them up well. A high wind may otherwise do much damage.

Insect enemies must be watched and proper spraying done.

AUGUST

Vegetables.—Tie up the outer leaves of cauliflower to blanch the heads.

The earliest crop of celery may need blanching this month (Fig. 126). Others begin the blanching when the plants are about half grown. Three methods are common: (1) A section of common drain tile, three or four inches in diameter, may be placed around each plant. (2) Soil may be mounded up by the rows. (3) Twelve-inch boards may be placed close to the plants on both sides of the row. These are held in place by stakes, and leaves or straw are placed between the plants inside the boards.

The onion harvest should begin when the bulbs are well formed, and the tops have died. Let the onions lie on the dry soil until cured. Then carefully move them to a dry place and spread in thin layers. The early crop should not be

FIG. 126.—Celery banked with dirt for blanching. A board blancher at left to show the structure. (Cornell Reading Circle Leaflet.)

stored for winter. Select good samples for the fall fairs and exhibits.

Prune the tops of a portion of the tomato plants to prevent further blossoming. This will force the fruits already formed to ripen earlier. Pick the earliest before they ripen and let them color off of the plants.

A second crop of the quick-growing vegetables may be planted this month, if the soil is moist enough (Fig. 127).

Trees, Fruits and Lawns.—Cut out the oldest canes of blackberries and raspberries. Some gardeners even cut away all the canes of blackberries after picking is over.

Cultivate the bush fruits now. This helps the next year's crop.

Start a new strawberry bed in August if the season is moist (Fig. 128). Do not expect the old bed to last more than two years. The young bed should be coming on as the old bed goes. Set plants you have raised in the garden, or

Fig. 127.—Preparing the garden for a second crop. Each student has a section of a long row. Normal School, Providence, R. I. (Photo from Children's Flower Mission, Cleveland.)

buy them from seedsmen or florists. Early spring planting is preferable, but, if the season is moist, August planting is very successful.

Strawberries which are to be grown in-doors, or in hotbeds, may be potted in August and later transplanted to five- or six-inch pots. Keep them well watered with liquid manure.

If a privet hedge is growing about the grounds, August is a good time to prune it. Other ornamental shrubs should be kept in good form by heading back the long shoots and branches.

The orchard should be provided with a winter cover crop sown in August. Rye, crimson clover and winter vetch may be sown for this purpose.

Some nurserymen recommend the transplanting of evergreens in August. It can be done now if a ball of earth is kept about the roots and the trees are watered well after planting.

FIG. 128.—For small gardens the hedge-row system of growing strawberries is probably the most productive. (New Jersey Station.)

Flowers.—Look over fall catalogues and make lists of bulbs for autumn planting. They should be ordered this month. Look over all flowering plants and prune away the faded flowers and seed cases. Hips of roses and ripe seed of many perennials may be saved. Place the kinds in separate envelopes properly marked. The ripening of seeds on flowering plants takes much of their strength, and should usually be avoided by pruning earlier. A few seeds of annual flowers, suitable for use in windows next winter, should be started in some secluded ground now.

SEPTEMBER

Vegetables.—Before fall frosts occur, complete the harvest of tender garden crops, such as beans, sweet corn, cucumbers, melons, tomatoes, egg-plant and peppers. Squashes and pumpkins may be left until after the first frosts have killed the vines, but do not let the squashes be frozen.

Late tomatoes may be gathered while green and spread in single layers on shelves. They will ripen in-doors. This may extend the ripening period until October 15th, or later. Some gardeners pull up tomato plants loaded with green fruits, and hang them in protected places in the tool house or shed. The fruits will continue ripening for several weeks.

Fall sowings of lettuce, radish, spinach, kale, winter onions, and others, may be made in September. This will add much to the value of both the home and school garden. Extra early peas may be planted the first week of the month. If they mature this fall, so much is gained.

Hotbeds and coldframes should be made ready for fall and winter use. Radish, lettuce and spinach started in coldframes may be protected when winter comes on and yet mature their crops without extra heat.

Keep the celery well hilled up and well watered. Growth should continue rapidly after the blanching begins.

Trees, Fruits and Lawns.—Fall rains are apt to stimulate the growth of woody trees, including the bushes and fruit trees. All cultivation about these should stop. A cover crop, such as rye or wheat, will help to prevent late growth. The buds are likely to suffer during winter if growth continues in September.

The thrifty growth of grass should be kept well trimmed. Allowing extra growth to stand for winter protection is not a good plan.

Grass seed is likely to succeed if started well in September.

Flowers.—Hunt through the woods for hardy wild flowers. They can be better recognized now than in early spring. They may be transplanted in September by cutting off the tops of most of the leafy growth. Plant them in the wild garden.

Divide clumps of perennials in the hardy perennial border. Many which have given poor results the past season may be too crowded. Do not forget the clumps of dianthus, hollyhock and perennial phlox. Sow seeds of hardy perennials which are recommended by the catalogues for fall planting.

OCTOBER

Vegetables.- ·Watch for frosty nights and protect the late tender crops, or harvest them before injury. Read again the cautions for September.

Go over the cabbage patch several times and bend over those heads which re ripe or fully formed. This is to check the growth and prevent many bursted heads. Late in the month select the firmest heads for storage. They should be stored in a cold, dry place, but where they will not freeze too much. The temperature should be near the freezing point most of the time. A pile in a corner of the hay floor of a barn, covered with hay or straw, will keep until after Christmas.

Transplant the cabbages started from seed in September. They may be kept in coldframes. A cold cellar is a good storage place.

Mow and remove the tops from the old asparagus beds and apply several inches of good manure. Young beds may be started now. Plants started from seed in the spring may be transplanted to the permanent rows five feet apart. Soils should be light but should contain plenty of rotted humus and rich manure.

Rhubarb may be planted now. Onion seeds of hardy varieties may be planted in the open garden. It may be well to protect them later with a little mulch of leaves or light straw. The onion beds started in September may also be mulched as the ground begins to freeze.

Transplant parsley from the garden to the window boxes or coldframes. These will supply green garnish throughout the winter months. They do not require much light.

Dig the sweet potatoes when the vines have been touched by frost. Handle them as carefully as eggs to prevent bruising. They should be sorted and only the soundest kept for storage.

Trees, Fruits and Lawns.—Many trees and shrubs may be transplanted during the month. Fall planting is recommended for nearly all woody plants. Much time will be saved by doing the work now instead of in the spring. In most cases let the leaves drop before the trees or shrubs are moved. Broad-leaved evergreens, such as laurel and rhododendron, may have the old leaves removed at the time of transplanting. The young leaves should be kept.

All hardy roses, such as ramblers and bush roses, can be planted in the fall as well as in the spring.

Early October in usually favorable for sowing grass seed except in the extreme North. Fall rains aid the growth and cool weather is also favorable.

Flowers.—If the weather is cold in October, the hardy bulbs may be planted in the beds for spring flowering.

This is a good time to plant lilies, lily-of-the-valley, delphinium, hollyhock, achillea, iris and other hardy perennials.

Ferns from the woods may be transplanted just before the ground freezes. The tops may be entirely cut off.

Remove the tops from any flowers that have been killed by frost. The grounds will look much better.

Take up the house plants early before frost kills them. Those that were "plunged" last spring, and others you may wish for the windows the coming winter, must be cared for now. Be sure to have some chrysanthemums ready.

NOVEMBER

Vegetables.—Give the rhubarb and asparagus beds heavy applications of manure before the winter sets in.

This is the month for fall plowing of the garden. Heavy clay soils should be plowed just before freezing. They may be left unharrowed. The action of winter weather will greatly improve their texture.

See that a good compost heap is started this month. Use in this all the wastes from the garden, including vines and stems of annuals of all kinds. Cow manure should be put in layers a few inches thick, alternating with layers of inverted sods.

Root crops of several kinds may be buried for winter use. Try beets, turnips, carrots and rutabagas. Parsnips and salsify may be left in rows where they were growing. A little mulch may be put over them. They will improve in flavor by freezing.

When the ground begins to freeze remove celery from the garden to a pit or cellar. The long plants may be transplanted and set close together in deep boxes, with only a little soil about the roots to hold the moisture. If the boxes are loose and crate-like on the sides, so much the better. The stems are less likely to discolor. Water the roots carefully without wetting the tops.

This is the best time of year for drainage work, particularly if the season is not too wet. Install drains where they are most needed. Land drains are of more value than many would suspect.

All the extra garden tools should be gathered up and put in winter storage. All unpainted parts should be given an application of wagon grease rubbed on with a cloth. This will prevent rust and insure their coming out in good condition in the spring. Handles and other wooden parts may be painted or given a coat of linseed oil.

Trees, Fruits and Lawns.—Cover the strawberry beds with coarse strawy manure or other mulch for the winter. Clean straw, leaves, light pine boughs, and corn stalks are sometimes used for this purpose (Fig. 129).

Manure should be placed about the bush fruits, and perhaps about the lawn shrubs. Rhododendrons and laurels require some protection over the ground; either a coarse mulch or manure. In the coldest regions light straw is thrown among these broad-leaved evergreens and left until spring.

Stratify peach and plum pits now. They will be suitable for use in starting the seedlings for next year's budding. Look carefully over the tops of all trees when the leaves

FIG. 129.—The winter mulch of straw protects the strawberry plants from heaving out by frost, and in the summer protects the fruit from the soil; keeps down weeds, and saves moisture in the soil. (New Jersey Station.)

are off for bag worms, tent caterpillar nests, egg masses and other signs of insect enemies. These may be pruned out or picked off and destroyed.

Transplant some little evergreens, such as pines, spruces, and cedars to pots, cans or window boxes. They will add much cheerfulness to the winter collection of house plants.

Top dress all the grassy lawns with half-rotted manure to make a complete cover. This is to remain until early spring.

Flowers.—If the bulbs for spring flower beds have not been set they should be attended to the first thing this month. Later cover the beds with a mulch of straw or leaves.

Sweet peas may be planted in November. They will blossom much earlier in the spring. Fill the trench with very rich compost and let the seeds be planted six inches deep. They will not start until spring.

Cinerarias, dwarf French marigold and perhaps other annual flowers planted in July or August may be protected till November, and then transplanted into pots for the window garden. They will give a fine show of blossoms through the winter. Lilies-of-the-valley, Roman and Dutch hyacinths and Chinese lilies should be placed in pots of soil in a cool cellar during this month. Let the growth be controlled by the temperature so that they will be ready for blossoming about Christmas time, or whenever desired. When the bulbs begin to swell bring them out to the light.

This is the best month of the year for chrysanthemums. Plants should be potted in time for use for a show in windows.

DECEMBER

Vegetables.—Mushrooms may be started in half-rotted manure in a dark cellar or pit. Plenty of water and occasional ventilation may be recommended. The heat required for the growth comes from the rotting of manure.

Transplant some of the garden crops to boxes and keep them fresh in the cellar. This is possible with such crops as cabbage, carrots, kale, salsify, parsnips and green onions. Keep the roots covered with sand, sod or soil to prevent wilting. This plan of storage is not permanent, but will keep a few such vegetables fresh in the cellar for a month or two.

The out-door garden crops, which are to stand the winter, should now be well protected with litter of some kind. The amount of cover will depend somewhat on the location or latitude, and the kind of crop. Kale, winter onions and spinach may be kept in this way.

Hotbeds may be kept going, or at least started for next month's planting. Winter crops may be grown in them continuously. The amount of growth will be governed by the covering. If the beds are in a sunny exposure and protected from north winds the plants will do much better. Potted plants and boxes may be made ready here for moving to the windows from time to time. Thus a fresh supply of all kinds of growth are available throughout the winter.

Trees and Fruits.—December is a very suitable time to begin pruning. More pleasant weather for the work is found now than in January.

Protect tender roses, such as the teas and their hybrids, by tying about them bundles of stalks or straw to prevent winter growing.

Flowers.—Make double boxes for use in the windows to keep the soil from cooling too much in severe weather. One box is set inside a larger one and packing is placed between the sides of the two boxes and underneath the inner box. Suitable packing material is sawdust or tightly crumpled newspapers. Schools using such double boxes will find it much easier to protect the plants over Sunday when the building becomes cold. The tops of the plants may be protected by wrapping with newspapers. During the coldest weather these boxes should be set in the warmest part of the building, or in the cellar over Sunday.

The window boxes should be given utmost attention from now on. Keep everything in a thrifty condition. Use liquid manure or solutions of nitrate of soda for watering those where growth is desired. A little potash and phosphate in the water is better for the flowering ones. Study the light relation. Some plants can endure more shade than others. Such is true of begonias, ferns, dracænas, palms, vincas, fuchsia, English ivy.

A good sunny exposure is required for such window plants as abutilon, sweet alyssum, geranium, marguerites and petunias.

Vegetable Garden Record. Dates are for the Latitude of New York (Cornell Reading-course Leaflet.)

Name of vegetable	Seed for 100 ft.	Time to plant seeds: Hot-beds	Time to plant seeds: Cold-frames	Time to plant seeds: Open ground	Depth to plant seed (inches)	Time to transplant	Distance apart of rows: Horse culture	Distance apart of rows: Hand culture	Distance apart of plants in rows	Ready for use after planting
Artichokes, globe	1 oz.	March	April	May	½	May	3 to 4 ft.	2 to 3 ft.	2 to 3 ft.	15 months.
Asparagus	60 to 80 plants			April or May		April or May	3 to 5 ft.	12 to 24 in.	12 in.	2 to 3 years.
Beans, dwarf	1 pt.	March	April	May to July	1	June	30 to 36 in.	18 to 24 in.	3 to 4 in.	45 to 65 days.
Beans, pole	½ pt.	March	April	May or June	1	June	3 to 4 ft.	2 to 3 ft.	3 to 4 in.	50 to 80 days.
Beets	2 oz.	March	April	May to Aug.	½ to 1	May	24 to 36 in.	12 to 18 in.	4 to 6 to foot.	60 to 85 days.
Brussels sprouts	¼ oz.	March	April	May, June	½	May, June	30 to 36 in.	18 to 24 in.	12 to 18 in.	95 to 120 days.
Cabbage, early	¼ oz.	March		April, May	½	April, May	30 to 36 in.	18 to 24 in.	12 to 18 in.	90 to 100 days.
Cabbage, mid-season	¼ oz.		April	May	½	May, June	30 to 36 in.	24 to 30 in.	16 to 24 in.	100 to 120 days.
Cabbage, late	¼ oz.		May	June	½	June, July	36 to 42 in.	30 to 36 in.	20 to 30 in.	100 to 130 days.
Carrots	1 oz.	March	April	May, June	¼ to ½		24 to 30 in.	12 in.	2 to 3 in.	75 to 110 days.
Cauliflower	¼ oz.	April	May	May, June	½	May, June	30 to 36 in.	18 to 24 in.	14 to 18 in.	100 to 130 days.
Celery, early	¼ oz.	March		April	¼ or less	April	3 to 6 ft.	18 to 24 in.	3 to 5 in.	120 to 130 days.
Celery, late	¼ oz.		April	May	¼ or less	May, June	4 to 6 ft.	24 to 42 in.	4 to 8 in.	130 to 150 days.
Corn, early	¼ pt.	April	April	May	1 to 1½	May	30 to 36 in.	18 to 24 in.	Hills 18 to 24 in.	65 to 90 days.
Corn, late	¼ pt.			May, June	1 to 1½		36 to 42 in.	30 to 36 in.	Hills 30 to 36 in.	75 to 100 days.
Cucumbers	½ oz.	March	April	May, June	½ to 1	May	4 to 6 ft.	4 ft.	Hills 4 ft.	60 to 80 days.
Dandelion	¼ oz.		Ap to Ag	May	½		24 to 30 in.	12 to 18 in.	12 to 18 in.	6 to 12 months.
Endive	1 oz.	March	April	June to Aug.	½	April	24 to 30 in.	12 to 18 in.	12 to 18 in.	90 to 130 days.
Kale	¼ oz.		April	June to Aug.	½	May	24 to 30 in.	18 in.	18 in.	90 to 120 days.
Kohl-rabi	¼ oz.	April	April	May to July	½	May	30 to 36 in.	12 in.	12 to 18 in.	60 to 80 days.
Leek	½ oz.	April	May	May, June	½	May, June	24 to 30 in.	6 to 12 in.	4 to 8 in.	120 to 180 days.
Lettuce	½ oz.	March	Apr. on	April to Aug.	½	May on	24 to 30 in.	10 to 12 in.	Head 10 in.	60 to 90 days.
Muskmelons	½ oz.	April	April	May, June	½ to 1	May	6 to 8 ft.	6 ft.	Hills 6 ft.	120 to 150 days.
Onions	1 oz.	March	April	April, May	½	April, May	24 to 30 in.	1 ft.	2 in.	130 to 150 days.
Parsley	¼ oz.	March	March	April, May	¼ to ½	April, May	24 to 30 in.	12 to 18 in.	3 to 6 in.	90 to 120 days.
Parsnips	½ oz.		April	April, May	¼ to ½		30 to 36 in.	12 to 18 in.	3 to 4 in.	125 to 160 days.
Peas, early	1 qt.		April	April	1 to 2		3 to 4 ft.	18 to 24 in.	Close	40 to 80 days.
Peas, late	1 qt.			May, June	1 to 2		4 to 5 ft.	24 to 36 in.	Close	65 to 90 days.
Peppers	⅛ oz.	March	April	June	½	May, June	30 to 36 in.	12 to 18 in.	15 to 18 in.	100 to 140 days.
Potatoes, early	5 to 8 lbs.		April	April	3 to 5		30 to 36 in.	24 to 30 in.	12 to 14 in.	80 to 100 days.
Potatoes, late	5 to 8 lbs.			May, June	3 to 5		36 to 42 in.	30 to 36 in.	12 to 18 in.	100 to 140 days.
Pumpkins	½ oz.		April	May, June	1 to 1½		8 to 12 ft.	8 ft.	Hills 8 ft.	100 to 140 days.
Radishes	1 oz.	March	April	April to Sept.	½		24 to 30 in.	8 to 12 in.	1 in.	20 to 40 days.
Salsify	1 oz.		April	May	½ to 1		30 to 36 in.	12 to 18 in.	4 to 6 in.	120 to 180 days.
Spinach	1 oz.	March	April	Ap, May, Aug	½		30 to 36 in.	12 to 18 in.	3 to 4 in.	30 to 60 days.
Squash	½ oz.	April	April	May, June	1 to 1½	May, June	3 to 10 ft.	3 to 8 ft.	Hills 3 to 8 ft.	Bush 60 to 80 days, running 120 to 160 days.
Tomatoes	⅛ oz.	March	April	June	¼ to ½	June, July	3 to 5 ft.	18 to 36 in.	1½ to 3 ft.	100 to 140 days.
Turnips	½ oz.	March	April	April to Aug.	½	April May	30 to 36 in.	12 to 18 in.	6 to 10 in.	60 to 80 days.
Watermelons	1 oz.		April	May, June	1 to 1½	May	8 to 12 ft.	8 ft.	Hills 8 ft.	100 to 120 days.

Farm Garden Record. Dates are for Latitude of Kansas (Kansas Station)

Vegetable	Varieties in order of production	Date of setting or planting	Amount of seed	Depth of planting, inches	Distance between rows, feet	Distance apart in row, inches (or feet)	First picking	Last picking	Yield to 100 feet
Beans	Stringless Green Pod	May 10	1 pt. to 50 feet	2 to 3	3	6	June 27	July 18	48 qts.
	Bush Lima	May 10	1 pt. to 50 feet	2 to 3	3	6	June 27	July 18	46 qts.
Beets	Crosby's Egyptian	April 6	1 oz. to 50 feet	½	1 to 1½	2 to 4	June 11	Sept. 11	450 lbs.
Cabbage	Premium Flat Dutch	April 24	1 oz. to 1500 plants	½	3	24	June 27	July 21	41 heads, 54 lbs.
	Early Jersey Wakefield	April 24	1 oz. to 1500 plants	½	3	24	June 27	July 21	45 heads, 52 lbs.
Carrots	Early Chantenay	April 1	1 oz. to 100 feet	½	1 to 1½	2 to 4	July 20	Nov. 1	240 lbs.
	Half Long Danvers	April 1	1 oz. to 100 feet	½	1 to 1½	3 to 5	Aug. 10	Nov. 4	120 lbs.
Celery	Giant White Pascal	July 13	1 oz. to 3000 plants	⅛	3 to 4	6	....	Sept. 28	180 heads.
	White Plume	July 13	1 oz. to 3000 plants	⅛	3 to 4	5	....	Sept. 15	220 heads.
Cucumbers	Arlington White Spine	May 8	1 oz. to 50 hills	½	4 to 6	4 to 6 ft.	July 25	Sept. 20	1799, 150 lbs.
Lettuce	Black Seeded Simpson	April 12	1 oz. to 150 feet	½	1	3 to 4	May 28	....	264 lbs.
	Improved Hanson	April 12	1 oz. to 1000 plants	½	1	3 to 4	June 1	....	244 lbs.
Onions	Giant Gibraltar	April 12	1 oz. to 100 feet	½	1	3 to 4	Aug. 22	....	28 lbs.
	Prizetaker	April 12	1 oz. to 100 feet	½	1	3 to 4	Aug. 22	....	21 lbs.
Parsnips	Hollow Crown	April 12	1 oz. to 200 feet	½ to 1	1½	2 to 4	....	Oct. 9	56 lbs.
Peas	Nott's Excelsior	April 12	1 qt. to 100 feet	3	3 to 3½	1 to 2	June 8	July 19	21 lbs.
	Gradus	April 12	1 qt. to 100 feet	3 to 4	3½	1 to 2	June 8	July 19	20 lbs.
Radishes	Early Scarlet Turnip	Mar. 22	1 oz. to 100 feet	½ to 1	1	1 to 2	May 1	May 20	3077 roots.
	White Strassburg	April 10	1 oz. to 100 feet	½ to 1	1	1 to 2	May 20	June 1	2607 roots.
Salsify	M. Sandwich Island	April 25	1 oz. to 70 feet	½ to 1	1½	2 to 4	....	Sept. 4	50 lbs.
Spinach	Victoria	Mar. 25	1 oz. to 100 feet	1 to 2	1 to 1½	2	May 11	June 17	75 lbs.
Squash	Summer Crookneck	May 16	1 oz. to 20 hills, or 8 to	1 to 2	7 to 8	7 to 8 ft.	....	Aug. 7	13 squash, 39 lbs.
	Hubbard	June 20	12 seeds per hill	1 to 2	10 to 12	10 to 12 ft.	....	Sept. 9	9 squash, 35 lbs.
Sweet Corn	Mammoth White Cory	April 20	1 qt. to 200 hills, or	2	3	2½ to 3 ft.	June 23	July 16	91 lbs.
	Stowell's Evergreen	April 20	¼-qt. to 100 feet	2	3	2½ to 3 ft.	June 23	July 16	87 lbs.
Tomatoes	Earliana	May 12	1 oz. to 1500 plants	½ to 1	4	4 ft.	July 12	Sept. 18	420 lbs.
	Stone	May 12	1 oz. to 1500 plants	½ to 1	4	4 ft.	July 12	Sept. 18	405 lbs.
	Dwarf Champion	May 12	1 oz. to 1500 plants	½ to 1	4	4 ft.	July 12	Sept. 18	217 lbs.
	Trucker's Favorite	May 12	1 oz. to 1500 plants	½ to 1	4	4 ft.	July 12	Sept. 18	230 lbs.
Turnips	Early White Milan	July 3	½-oz. to 100 feet	¼ to ½	18 in.	6 in.	Aug. 15	Oct 1	150 lbs.

CHAPTER XIX

GARDEN CALENDAR FOR SOUTHERN STATES

THERE is less need for making a gardeners' calendar for the southern states than there is for the northern states. The planting seasons in the South are always longer than in the North, and there is much greater opportunity for choice in the matter of dates for starting the various kinds of crops.

The calendar for southern states is given for those who are not very familiar with the climate; and for those who may know the climate, but who are not so well informed about the hardiness and adaptation of different plants; and those who do not know the best temperature or kind of weather in which various garden crops thrive best. The calendar should be considered as suggestive in its nature rather than as a set of rules to be followed absolutely. The latitude to be kept in mind in the reading of this chapter is about 33° or 34°, where the average date for the first killing frost of winter is from the first to the middle of November. For regions farther south or north the dates may be varied somewhat.

For the parts of Florida south of the annual frost line, the planting season really begins about the first of September and extends through to the hot weather months when the starting of most garden crops must cease because of the burning sun.

Market demands for the various crops often govern the times for planting in the southern states. In certain regions of commercial gardening the market has more influence than the season in this respect. For example, celery may be planted to get the crop into market ahead of the northern grown crop. Independent of season in Florida, celery is planted in January, October and April.

JANUARY

Vegetables.—Plan the school garden early. Every home garden should have more vegetables than before. There is money in vegetable gardening. Let the size of the garden be increased (Fig. 130).

Sweet potatoes may be started in a coldframe or hotbed to produce plants for setting in the open about March or April.

Fig. 130.—The school garden is to train for home gardening. The culture, arrangement, crops, etc., should be like those to be used at home. (Photo from Children's Flower Mission.)

Wait for the sunny days and give them plenty of air. They must be hardened off before planting. Use hotbeds or window boxes to start celery seed in January.

White or Irish potatoes may be planted before the month is over, if the soil and weather are fit.

Asparagus may be started from seed sown this month. Seedling plants started last year may be transplanted to rows. Set the plants six inches deep and twelve to eighteen inches apart in the row. Commercial gardeners leave four or five feet between rows. The soil must be made as rich as possible with compost or fresh manure. Old beds should be liberally manured. The coming crop will be much better.

It is not too early to risk a few of the hardy vegetables out-of-doors late in January. Make a trial of early cabbage plants, English pea seeds, onion sets and seeds, carrots, parsnips, beets, lettuce, radish, spinach, turnips, rutabagas and kohlrabi. A hardy lettuce for such early planting is Hanson or Wonderful, which is known also as the Shellem lettuce.

The winter garden should be carefully worked, and prepare the soil for the spring garden to catch and hold moisture.

Flowers.—Plant sweet peas in deep trenches where they will have plenty of sun in the early morning.

The house plants should be well cared for. They constitute the main flower garden at this season. See that all dead parts are removed. Give them plenty of water. A little liquid manure will stimulate any that are declining. Watch for insect enemies and use the best remedies promptly.

Dahlias may be started from seed, as new colors are thus found. Those from seed vary in color while those from roots do not. Seed started this month may be expected to produce flowering plants next fall.

The most hardy annual and perennial flowers may be planted in the open garden late in January. Many of them are not easily transplanted, and the seed may be sown where the plants are to remain until flowering time.

The following are popular hardy flowers: Alyssum, snapdragon, fox glove, hollyhock, poppy, pansy, phlox, candytuft and larkspur. The young seedlings may be protected by leaves or other covers during late cold snaps. Many of them started in coldframes will bloom by May.

Trees and Fruits.—The last of January, if not too wet, is a good time for transplanting all kinds of shade and fruit trees, vines and shrubs. Have the ground well prepared and the holes made a little in advance. Never expose the roots to the air long.

Pruning should be completed if possible this month. Cut away the dead branches. Thin the heads of fruit trees. Never allow limbs or twigs to rub.

Finish the winter spraying. Read the directions for use of lime-sulfur and keep scale insects in control.

This is the last chance to take cuttings of any woody plants which are to be grafted, budded or started on their own roots later in the spring. Do not forget grape vines,

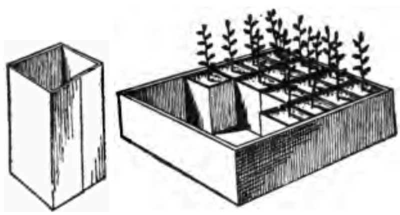


FIG. 131.—Pasteboard "pots" are often used in transplanting seedlings. These may be set in the garden later without removing the pots.

currants, gooseberries, Le Conte pears, Marianna plums and the many ornamental shrubs.

All the in-door work, such as root grafting, should be completed.

If the lawns were not dressed with stable manure last fall, throw on a thin coating of fine compost. A little top dressing of lime is also good at this time.

FEBRUARY

Vegetables.—If you are to plant rhubarb this year, have the work completed this month. Plant the roots in rich, moist soil. They will stand much manure. Horse-radish and asparagus roots may be planted now. The perennial garden herbs, such as sage and thyme, may be started either from roots or seeds.

Use the hotbeds to start such tender vegetables as tomato, egg-plant and pepper (Fig. 131). The seed may first be sown in window boxes and as the second pairs of leaves are forming transplant them to the hotbed.

More sweet potatoes should be bedded this month, and Irish potatoes may be planted for the purpose of succession in cropping. Irish Cobblers are popular for planting now.

More of the early hardy vegetables may be started from seed. Plant English peas, radish (Fig. 132), beets, carrots, endive, kohlrabi, salsify, parsley, parsnips and turnips in the open garden. Celery may yet be started in hotbeds or window boxes for planting out in April.

Fig. 132.—The early scarlet radish is a favorite in children's gardens, as the crop matures very quickly.

If you have started early cabbage in the hotbed or window box, get it well hardened and set part of the crop in the garden. Early cabbage should be kept going in a succession of plantings. Sow extra early Empress, early Jersey Wakefield, Charleston Wakefield, and other favorites in coldframes or protected beds for later transplanting. Cauliflower should be started.

It is not too early to try a number of slightly tender garden crops now, but do not expose the tender plants to frost.

Watermelon, muskmelon or cucumbers may be started now, if the hills are protected on cold nights with boxes or other covering, and if the soil and location are warm.

Other tender vegetables to be planted in smaller quantities now are beans, okra and young plants of tomato, peppers and egg-plants, in warm soil and protected places.

The more tender vegetables should be planted late in the month, and the hardy ones before the middle of the month.

Keep the garden soil well cultivated from now on. Never allow the ground to become crusted or cracked. If it has a cover crop do not destroy that yet, except for the place where you want to start the garden now.

Flowers.—Begin the planting of gladiolus, cannas, dahlias, and tuberoses, in coldframes or places where they may be protected from frosts after they start growth.

Pansies that have been started in coldframes may be transplanted to the garden. If they have been in the garden all winter under cover remove the litter and rake in some well-rotted compost.

In the coldframes, start seeds of asters, begonias, heliotropes, lobelias, petunias, pyrethrum, castor beans, cyclamens, scarlet sage, Chinese primrose and verbenas. As they start transplant enough to prevent crowding.

If chrysanthemum and carnation cuttings have not been started they should be rooted early this month. If ready, chrysanthemums may be transplanted to the open beds late in February. Carnations are more tender. Cuttings of coleus, in several colors, may be rooted in beds now.

It is not too late to plant some seeds of sweet peas and perennial phlox.

Trees, Fruits and Lawns.—Part the mulch over a few of the rows of strawberries. Let the plants come through early this month. If no mulching was done last fall give the bed a thorough cultivation and put on the mulch to protect the crop while forming.

Strawberry plants may be set now. Use care in planting to avoid exposure of roots while planting. Set them as deep in the ground as possible without covering the crown bud with soil.

Examine peach trees for borers. Remove the soil with a hoe around each tree about two inches deep. Watch for the borings and the formation of gum. Kill the worms with a wire or sharp-pointed knife. After the trees are all gone over in this way, mound the soil up above the level. This process is to be repeated two or three times a year.

If the spring is late, and buds are not yet open, some pruning and spraying may be done early in the month. If the season is early and the blossoms are open, watch for the proper time to spray for curculio and codling moth.

All planting of trees and shrubs should be pushed this month. Tea roses and other hybrids may be safely handled in the open.

Rake the lawns, remove the winter dressing and roll the grass with a heavy roller. The first mowing may be necessary before the month is over. Grass seed should be sown early in the month where the sod is thin. Top dress with lime and commercial fertilizer, chiefly phosphate. Nitrogen may be applied later.

This is a good month for sodding banks and borders along walks and driveways.

Hedges should be pruned and the litter raked from under them. Give the grounds a cleaned-up appearance. Rake the driveways, fill in the washed out places and go over with a log drag or King road drag.

MARCH

Vegetables.—A few tender vegetables may now be put out without much fear of frost. But make the main plantings of bush beans, pole beans, sweet corn, okra, squashes, cucumbers and melons, the last of March or in April.

Transplant to the open garden cabbage, cauliflower and some of the celery, tomatoes, egg-plants, peppers, sweet potatoes (Fig. 133).

Early in the month plant Irish Cobbler potatoes for home use and market.

Make more plantings of several of the early hardy vegetables early in March. This will give crops later than the same kinds planted in January and February. You may need more of beets, English peas, turnips, kale, mustard, lettuce, radishes, spinach, endive, carrots and parsnips.

If the cabbage, cauliflower and Brussels sprouts are not all out, set them in the open garden now.

Flowers.—Sometime in the month you can probably put out the tender bulbs. Set roots of gladiolus, dahlias, cannas and caladiums in the garden where they are to grow all season.

Keep pansies and sweet peas well watered. The show of

FIG. 133.—The hands should pack the soil firmly around the plant to draw moisture to the root. A little loose mulch may be left on top. (Dunham Co., Berea, Ohio.)

blossoms later will pay for the work. A little liquid manure may be used.

If you believe in planting dahlia seeds, the earlier it is done the better.

This is the best time for planting seeds of the following annual flowers: Aster, alyssum, balsam, cock's-comb, cosmos, candytuft, marigold, nasturtium, petunia, phlox, poppy, and verbenas.

Trees, Fruits and Lawns.—Look over the suggestions for February and if the work mentioned was not all completed some of that may be done now.

Keep the lawns well cut and the roads well dragged.

Spraying for codling-moth, cankerworm, plum curculio and other insects will probably need to be done this month, or April. Watch when the petals fall.

Cultivate the soil about the bush fruits and apply well-rotted manure. Some commercial fertilizer rich in potash, or unleached wood ashes will increase the fruit crop this year.

APRIL

Vegetables.—If the weather remains cool, the latest plantings of hardy vegetables may again be made. Probably the weather is too warm for English peas. Try more beets, spinach, radishes and lettuce.

All kinds of beans and the edible cowpeas may be risked now. Watermelon, muskmelon, cucumbers, summer squash, and hubbard squash grow well in warm April days. They are the natural hot-weather crops.

Plant Country Gentlemen sweet corn and other favorite varieties.

If you have more plants continue to set out peppers, egg-plants and tomatoes; also cabbage and cauliflower. Seeds of late varieties of the last two may be planted in the open garden.

School gardens intending to try experiments in cotton growing should test the seed this month and plant in May.

Have the ground well prepared and very rich. Make the conditions favorable for the experiments.

The sweet-potato ground should be made ready and the main crop set this month and next. The ground should be very moist at the time of planting. Use commercial fertilizer rich in potash and apply well-rotted compost.

Peanuts should be planted now. Other plantings may be made later.

Flowers.—Chrysanthemum and carnation plants may be set in garden rows for cultivation through the summer. If the roots of dahlias, caladiums and cannas are not out, set them now.

This is a good time to put out the bedding plants. Castor beans, coleus, flowering geraniums, and others, will probably do best outside now. Continue to plant seeds of annual flowering plants in the open garden where they are to blossom. See the March list. Do not forget the annual vines, such as gourds, "wild" columbine, cypress, morning glory, and flowering beans, such as lablab.

Trees, Fruits and Lawns.—If you are to raise your own strawberry plants, either for planting a new bed or for forcing, select runners from the strongest plants of the preferred variety. Plants for winter house use may be started in pots plunged in the soil near the rows. Keep the new sets well watered. They should grow vigorously until transplanting time in September. Keep the blossoms all picked off this season.

Strawberry beds must be gone over frequently to prevent runners from taking root, except where young plants are desired. They take away the strength of the main plants and reduce the fruit crop. The matted rows may produce more berries, but they are small and less desirable.

Spray the currants with Paris green to keep off the worms until the fruit sets.

Fruit trees should be given another spraying with Bordeaux mixture and Paris green a few weeks after the fruit has set to combat scab and other fungous diseases, and late attacks of insects.

Watch all ornamental shrubs and shade trees and see if they are being attacked by leaf-eating insects or plant lice.

Plants cannot withstand insect attacks at this season so well as in late summer.

If the weather is dry the lawns will need watering. Do this at night by flooding the grass with water in large amounts. Let it soak in well before the sun bakes the surface. A thin dressing of rich black soil will help to keep the lawn green through the summer. Nitrate of soda may be applied now to stimulate growth in the poor spots.

MAY

Vegetables.—Late plantings of bush and pole beans should be planted early this month.

A fall crop of celery may be started from seed in coldframes or well-watered beds. Shade the young plants from the hot sun. Plants started earlier may be set out now for the early celery crop.

Lettuce may be started in shady beds if kept well watered.

Hot-weather vegetables, such as melons, cucumbers and squashes, may be planted. The hills should be six or eight feet apart each way. Use plenty of seed in each hill to allow some for the insects. Thinning may be done, if necessary, when the plants are a few inches high. Very rich compost should be placed in each hill.

Early hardy vegetables harvested this month will leave vacant places. Fill these with corn, sweet potatoes and late vine crops.

Late Italian cauliflower, late cabbage and collards may be planted in hills three and one-half feet apart each way. Put several seeds in each hill and mark the place with a spoonful of lime on top. The struggle with weeds is easier if you can see the hills from the very first.

It is still not too late to set out egg-plants, peppers, tomatoes and to plant some Irish potatoes.

Keep the cultivator going. A garden rake is a good mulch former for summer gardens.

Schools, which have a long summer vacation, starting soon, should make plans for this. The early crops may be harvested and the ground planted with crops to be harvested in the fall after school is open. If no one is to care for the school garden during the summer, sow a small crop of cowpeas or soybeans.

Flowers.—The vines mentioned last month may be planted this month. Sow the seed where the plants are to remain. Use annual vines to hide unsightly parts of the premises, or to climb on screens forming backgrounds for flower gardens.

Many of the tender annual flowers may still be sown in the open garden, but put them where they will not need transplanting. Hot weather is a bad time to transplant them.

Keep the flower beds well watered and the soil well stirred. If the plants have a struggle at this season, the summer and fall show of flowers will be much reduced.

Trees, Fruits and Lawns.—The cultivator should be used about all trees and bush fruits. Growth should be stimulated now.

This is perhaps the best time to thin peaches, apples, pears and plums on the trees. Do it early. Never allow the fruits to touch each other after reaching full growth. The result of thinning is larger and better fruit (Fig. 138).

Small pruning with the fingers may begin late this month. Remove all unnecessary growth from fruit trees as soon as found.

Apple trees must be watched closely for borers.

Keep the strawberry beds free from weeds and grass. When the harvest is over in the bearing beds, remove the mulch, mow the vines, rake all the litter off and put it in the compost heap. Stimulate a new growth by cultivation. Water the bed if the weather is dry. Cultivation should follow the watering and continue throughout the summer.

JUNE

Vegetables.—A number of crops for fall harvesting may be started now. Make plantings of collards, rutabagas, and plant sweet corn early and late in the month.

Plant a few more hills of squashes, pumpkins, cucumbers, watermelons and muskmelons. At this season give them plenty of water to germinate the seed and keep the plants growing.

Sweet-potato vines may be set when the soil is moist enough. If irrigation is possible a larger crop may be grown.

The tomatoes already planted will probably continue to yield until fall frosts kill them. It is a little better, however, to start young plants this month, as the fruit from these will be better for late picking and canning.

Flowers.—Pansy seed may be started this month to grow plants for use in the window boxes next winter.

In the flower garden sow seeds of aster, marigold, nasturtium and other quick-growing annuals. These will bring forth a good show of fall flowers, if they are well watered through the dry season.

If you have been holding on to some of the house plants till now, better plunge the pots in a garden spot protected from the wind. Keep flowers well cut off and let the plants make a good growth of vegetation through the summer. A little liquid manure will stimulate this kind of growth.

Go over all of the flower beds and cut out the stems that are through blossoming. The ripening of seed is a severe strain on the plants and will reduce their show of blossoms. If seeds are wanted, select a few of the best plants and save them for that purpose. Collect seeds of sweet pea, poppy and others that you have admired.

Trees, Fruits and Lawns.—As soon as the blackberries and raspberries are through bearing, prune out the oldest canes. From now on cut back the young canes at a height of about three feet, and reduce the long branches by summer pruning. Keep the plants bushy, and thus increase the fruit next year.

Continue to summer prune both the young and the old fruit trees. This is done by removing the young shoots on the trunks, main branches and other places where they are not wanted. No tools are necessary if the work is done when the young growth starts. Such summer pruning forces the growth into other parts for the remainder of the season.

The lawns can hardly be kept too wet at this season.

In the absence of rain, flood the grass with water at night once a week. Let it soak in deep so the roots will penetrate the soil and not suffer so much from drought. Light sprinklings are apt to cause the roots to grow toward the top and suffer more from drought.

JULY

Vegetables.—This is probably the last month for the planting of Irish potatoes. Use the Green Mountain variety early in the month, and Lookout Mountain later on. In very warm soils a good plan is to mulch the summer planting with litter free from weed seeds, such as straw, marsh hay, leaves or pine needles. This will help to keep the soil cool, prevent the growth of weeds and hold the moisture. These plantings should produce the late crop for winter use. The seed for summer planting is obtained through dealers, from cold storage.

About the last of the month a little spinach may be sown for fall use.

Curled Scotch kale sown this month in open garden or transplanted will make large harvests and be fine for greens after frost. Norfolk kale is more hardy and will stand cutting until winter or in open weather all winter.

Boston head lettuce, or other good varieties, may be sown late in July or in August in partial shade to be transplanted later as a fall crop.

Chinese and Japanese winter radishes, if sown this month, will make immense roots for late fall and early winter harvest. They will live over winter if well mulched with manure or straw.

Cucumbers and cantaloupes started early this month, and well watered, will still make crops before frost.

Early varieties of snap beans can be planted both the first and last of the month. In warm weather each planting yields its crop for only a short time and a succession of plantings is necessary.

Early Adams sweet corn and other early varieties may be put in before the middle of July.

Irish Cobbler potatoes may still be planted. The level culture method is best for hot weather, and a heavy mulch, as suggested last month, should be used.

Late cabbage and cauliflower may be started as described before.

This is one of the best months in which to plant parsnips, salsify and half-long carrots. They will all grow until the ground freezes and the parsnips and salsify are improved in flavor by freezing.

Cuttings from tomato plants and sweet potatoes may be taken from the old vines and started in the open ground. Water them well at first.

Plant a few garden peas, early beets, and turnips.

Vigilance must be exercised in fighting cabbage worms on cabbage, cauliflower and Brussels sprouts; potato beetles on potato vines and egg-plants; striped beetles on all the vine crops; and flea beetles on Irish potatoes, egg-plants and many other crops. Use the remedies given in Chapter XX.

Plant more bush beans of quick-maturing varieties.

This is a good month to transplant the late celery crop, or part of it. The early planting of celery must be sprayed with Bordeaux mixture to prevent blight.

Canning clubs should be organized. Whether this is done or not, get a small canning outfit and thus save the vegetables and fruits from going to waste. Much money can be made in the home canning of vegetables and fruits. An outfit of suitable size is inexpensive. This will give a market for products when there is no canning factory nearby.

Flowers.—Make a collection of flower seeds from both the annual and perennial plants. Place each kind in a separate envelope, and mark both the name and the color. Possibly the color will not come true in all cases, and this will be an interesting observation.

This is a good month to start seeds of cineraria, cyclamen, primrose, and other annual flowers, to produce plants for use in the windows next winter.

Trees, Fruits and Lawns.—Cultivate the bush fruits now to aid next year's crop.

If you have grapes bearing now, protect them from poultry.

FIG. 134.—White Niagara grapes in a school garden. (Rittenhouse School Gardens.)

Be sure they are not hanging too low with the load of fruit (Fig. 134).

Keep the hedges well pruned about the grounds, and the lawn well mowed. This is a good time to use liquid manure on the thin spots in the lawn.

After the blackberry crop is all picked, prune out the old canes and make room for young growth (Fig. 135). Prune raspberries less severely by cutting out two-year-old canes and trimming others that are too high.

Prune out the dead rose heads and keep the bushes growing for the sake of a good show next year.

The orchard should be provided with a winter cover crop,

FIG. 135.—Blackberries grown in small gardens may be cut to the ground after each crop is picked. The bushes may then be kept low and less spreading. (New Jersey Station.)

sown late this month or early next month. Crimson clover is one of the best crops for this purpose. It is not too late to sow cowpeas and soybeans as green manure in the orchard to be disked or harrowed in about the first of October. A winter cover of vetch and rye may then be used.

AUGUST

Vegetables.—Persons in charge of school gardens should make such plantings now as will give results during the fall term of school. For this purpose sow bush beans, Chinese radish beds, endive, kohlrabi, lettuce, mustard, spinach, parsley, turnips, and rutabagas. Also set out plants of celery, late cabbage, cauliflower and Brussels sprouts. Tomato and sweet-potato cuttings may be made early this month, and produce crops before frost.

Keep the gardens well watered, remembering that many plants you are trying to grow prefer cool conditions, and more water is needed for this reason.

The cultivator should be kept going in hot weather. Remember the dust mulch principles, and apply them now.

Young pods of okra may be gathered and dried for winter use. Sweet corn may be boiled, cut from the cob, and dried in the oven, or hot sun, away from the flies. Such dried corn is sometimes preferred to that saved in cans.

This is a good time to save seeds of watermelon, muskmelon, tomato, early peppers and egg-plants. Always select the very best fruits for this purpose.

Flowers.—Perennial carnations may be started from seed in the open garden now. These will produce a good crop of flowers next year. Geranium cuttings rooted early this month will be good window plants during the winter.

Give special attention to the fall flowering plants, such as chrysanthemums, cannas and scarlet sage. Keep them well watered and occasionally apply some liquid manure.

Trees, Fruits and Lawns.—Each year, late in this month, start a new strawberry bed. Do not expect the old bed to bear more than two years. When the ground is moist transplant those plants you started from runners early in the season. If care is exercised they may be moved without serious check, and the new bed will bear next year.

If there are no potted strawberry plants to be grown in-doors next winter, prepare some for that purpose now. Select the largest plants of this year's runners, and put them in rich black soil. These may be plunged in the garden and kept well watered. They will be transplanted later to larger pots.

Do not forget the winter cover crop for the orchard. See the suggestion of last month. It is not a good plan to stimulate the growth of young wood on fruit trees late in the fall. A cover crop, as oats, will help to check the growth and cause the wood to ripen better. It is necessary that buds should mature well if they are to produce a good crop next year.

SEPTEMBER

Vegetables.—Large plants of cabbage, cauliflower, collards and celery may be set in the garden early this month for the production of winter crops. Onion seeds and sets may also be put in now and later. Plant more lettuce and radish seeds this month. Sow turnips for greens and for roots. Early beets may be planted. Carrots sown early may succeed this fall.

Select corn and cotton seed from the healthiest and most prolific plants. Follow the rules for selection given in Chapter XVII.

Crimson clover should be sown everywhere as a winter cover crop—in the tomato patch, cotton-field, corn-field, and all bare parts of garden. Thorough cultivation should be given the entire garden just before sowing the winter cover crop. This is a good time to apply stable manure to the soil, to rot for next year.

Flowers.—Make up lists of bulbs for fall planting from the garden catalogues.

Hardy annual flowers may be sown this month for use in winter windows. See August suggestions.

Perennial flowers of a number of kinds may be sown this month, and thus gain nearly a year over those sown next spring. If the weather is hot after the young plants are up, partial shade may be beneficial. Thorough watering in hot weather will also help.

Madonna lily bulbs are best planted early this month. Also roots of peonies and iris.

It is not too early to start such bulbs as hyacinths, Chinese lilies and narcissus for use in the windows later. These may be brought into bloom about Christmastime.

Trees, Fruits and Lawns.—Sow rye, wheat or fall oats, mixed with crimson clover in the orchard to check the late growth of trees. This may also be done in October.

The thrifty growth of lawn grass should be kept well trimmed. As fall rains begin the most beautiful lawn of the year may be maintained, if properly trimmed.

All flowering shrubs should be looked over to see that there are no dead stems, seed cases and other bad looking parts. Trim these out and let the lawns and grounds have a beautiful appearance through the entire fall.

OCTOBER

Vegetables.—In both school and home gardens make October plantings of early curly lettuce, early radishes, onion sets, shallots, spinach, and kale. If the fall remains warm, lettuce, radishes and onions from sets may be harvested. These will add much to the late fall and early winter vegetable harvest.

Toward the last of the month make other plantings in the coldframes of lettuce, radishes, spinach and onion sets.

Get the hotbeds ready for use a little later. See that the sash are all properly glazed and the frames are in repair. Have rich soil ready for use and the manure should be ordered or ready to haul.

Flowers.—Bulbs of narcissus, hyacinths, iris and tulip should be planted by the last of September. Other plantings may be made until the ground freezes, or until Christmastime. This plan will give a succession of blossoms next spring.

Gather seeds of the late summer flowers if you have choice kinds to perpetuate (Fig. 136).

Spinach and kale planted early this month may make a good start and live through the winter. In the coldest regions a little protection in the form of clean litter may be given. Dig the sweet-potato crop as soon as the vines have been touched by frost. Take care not to bruise the roots. This would damage their keeping qualities. Save the future seed potatoes from the hills yielding the most good roots. Sort the main crop and save only the soundest for storage.

Rake up all vines and waste litter in the garden after frost. Put this material in the compost heap to rot. This will kill most of the disease germs and insects.

If you have not sown a winter cover crop have the garden plowed or spaded now and sow some rye or oats and winter vetch for winter protection.

Flowers.—Take plants in the house soon. They should be trimmed, re-potted and given the best conditions possible to produce a winter show of flowers.

Sow seed of sweet peas during the month. Plant eight inches deep in rich black soil. The seed will not sprout until early spring, but fall planting will make the crop that much earlier.

Early spring flowering bulbs, mentioned last month, may still be put in the ground until it freezes.

On frosty nights protect the fall flowers and let them continue their beautiful show a few weeks longer.

Trees, Fruits and Lawns.—This is a good month in which to move any trees or shrubs. After the leaves are off, before the ground freezes, most of the year's planting should be done. Set out fruit trees, bush fruits, ornamental vines, shrubs and shade trees. Prune the roots a little at the time of planting, cutting off all broken or injured parts. The tops should be pruned to somewhat balance the pruning done on the roots.

Spread strawy manure about the hedges, rows of bush fruits, and around all trees. Do not use so much as to cause field mice to nest there.

It is not too late to set out strawberry beds. Blackberries do best if planted at this season.

Rambler roses and hardy bush roses can be planted this fall as well as in the spring. Early in November is one of the best times of the year to sod lawns. If sod is to be moved, do it now.

DECEMBER

Vegetables.—Except where the ground freezes too much, perennial garden crops may be planted. Set out asparagus, horse-radish, sage and other herbs. Start cabbage seed in frames for January and February setting. Onion sets may be started now.

Late in the month roots of asparagus may be dug and allowed to freeze for use in winter forcing. After freezing a few days or weeks plant them in boxes of soil in a warm cellar and water them well to bring on the new crop. The forcing may also be done by setting frames covered with glass over the plants right in the garden, in January.

Fill several coldframes with hardy vegetables, such as cabbage, cauliflower, celery, onion sets, spinach and kale. These will add much interest to the winter gardening.

Start the hotbeds now. Fill them one foot deep with fresh horse manure, well tamped. Over this fill in six or eight inches of rich garden soil. Bank the beds outside with manure and see that the sashes fit closely. As the manure begins to heat planting may begin. Throughout the winter keep succession crops of lettuce, early radish, spinach, onions, English peas and other choice vegetables.

Transplant some parsley from the garden to a pot or window box for the purpose of supplying green garnish for the table in the winter.

Flowers.—Attend to the planting of bulbs for the spring flower beds early this month. Later cover the beds with a mulch of straw or leaves.

Until the ground freezes sweet pea seed may be planted. Make the trench six or eight inches deep and fill over the seeds with well-rotted compost.

Cyclamen, cinerarias and dwarf French marigold planted

FIG. 137.—Strawberries should be grown in all Southern gardens. A large yield may be secured by cultivating the patch well and using a mulch of stalks or straw during the winter and spring until the crop is picked. (New Jersey Station.)

last August or September may now be potted for the window garden.

Lily-of-the-valley, Chinese lilies, calla lilies and Dutch and Roman hyacinths should be placed in pots of light soil and well watered. Keep them in a cool pit or coldframe a short time and then force them for late winter flowering.

The chrysanthemums should make a good showing of flowers this month. Give them the best of care.

Trees, Fruits and Lawns.—Strawberries may be forced in the hotbeds. Select strong plants which were potted **last**

spring or summer. Transplant them to five-inch pots and keep them watered with liquid manure. Wood ashes may be used to supply potash and increase the fruit crop. Pine needles on top of the soil will help to retain the moisture and keep the fruits clean.

This is the best time also to mulch the out-door strawberry beds (Fig. 137). Let the litter remain between the rows next spring until after picking time. Clean straw, marsh hay, leaves or corn stalks may be spread over the vines several inches deep.

Remember to spread manure about the trees, bush fruits, hedges and shade trees.

When the ground freezes, give the lawn grass a heavy dressing of half rotted barnyard manure.

Late in the month prune all fruit and shade trees, hedges, vines and shrubs.

CHAPTER XX

INSECTS, DISEASES, AND THEIR CONTROL

MUCH valuable training may be gained from the study of insects injurious to crops in the home and school garden. For detailed discussions regarding the many insects, their life histories and methods of combating them, reference is here made to special books and bulletins on these subjects (see Appendix).

Live insects may be studied and their developments traced by placing them in a cage shown in figure 139.

How Insects Feed.—There are two main types of insects based on their methods of obtaining nourishment: (1) Those with sucking mouth parts, such as squash bugs and scale insects. (2) Those with biting mouth parts, such as potato beetles and all true beetles, larvæ of moths and butterflies, including the cabbage "worm."

Methods of Control.—Substances used in the control of insects are divided into two groups: (1) *Contact insecticides,* which kill by smothering or closing the breathing pores on the bodies of the insects. These include dust materials and oils. (2) *Poisons,* which kill by entering the stomachs of the insects when they eat.

Insects with biting mouth parts are chiefly destroyed by poisonous sprays or powders on the plants which they eat. Suitable poisons for this purpose are Paris green and arsenate of lead.

Insects with sucking mouth parts are usually killed by kerosene emulsion, lime dust or other fine powders, which enter the breathing pores along the sides of the body.

Inside Feeders.—A few insects, such as tree borers (Figs. 140 and 141), codling-moth and plum curculio, are difficult to kill because of feeding inside the tissue of the plant.

They are protected by the plants which they are injuring.

Codling-moth is controlled by the application of poison just before the young larva enters the apple or other fruit. The worm-like larva eats its way into the fruit. If poison is present at that time, the insect will be destroyed.

Plum Curculio attacks plums, peaches, cherries and occasionally other fruits. The egg is laid in a small cut in the skin of the fruit when very small. When the larva hatches it

Fig. 138.—Sound fruit produced by systematic spraying. (New Jersey Station.)

eats its way toward the center. Poison applied just before the eggs are hatched will kill large numbers of larvæ, but this is not a perfect remedy. The adult insects before laying their eggs are often shaken to the ground and caught on sheets under the trees. This is best done in the very early morning. If this process is repeated for several mornings, just before or about the time the petals fall, numerous adult insects can be destroyed.

Peach Borer.—(Figs. 140 and 141.) This insect is the larva of a small moth with transparent wings. The eggs are laid on the rough bark near the surface of the ground, and the young, when hatched, eat their way under the bark and into the wood. The trees of cherry, plum, peach and others are affected by this insect. A gummy formation indicates the presence of the borer. Some sawdust borings may be noticed on the surface of the ground. Washing the trunks of the trees with some objectionable material, such as lime-sulfur wash, will repel the adults and prevent the laying of eggs there. This will probably protect the orchard from a large per cent of the borers. It is a common practice to dig into the trees for borers with wire or a sharp-pointed knife. This may be done twice a year in fall and spring. The dirt is removed from about the trunk a few inches below the ground level. A few days later digging for the "worms" should take place, wherever the gum or borings may be seen. All wounds made in this work should be covered with grafting wax rubbed in well. The dirt should again be slightly heaped up around the trunk. Protection against borers in the trunks of trees may be made by wrapping and tying well from soil to the lower branches.

FIG. 139.—Insect breeding cages add much interest to the gardening. Caterpillars and other larva may be kept on plants grown in the cages or kept fresh in bottles of water. Developments may be easily observed. (U. S. D. A.)

Apple Borers.—There are two kinds of beetles that attack the trunks of apple and pear trees. The beetles and grubs are quite different, but their work is similar. They are known as the flat-headed and the round-headed borers. The former attacks many other kinds of trees. The round-headed borer is the more serious enemy of apple trees. They live in the trunk about three years and then change through the pupa stage to the adult beetle.

The best remedy is to keep the adults from laying their eggs on the trunks by tying heavy paper or wire gauze about the

FIG. 140.—Peach tree borers may be easily dug from the trunk after the soil is removed from the base. Note the two borers just removed. (New Jersey Station.)

FIG. 141.—A method of protecting peach trees from the attacks of borers. The paper keeps the adult moth from laying her eggs on the trunk. (New Jersey Station.)

trees. The bottom of this protection should be slightly covered by soil and the top securely tied to prevent the beetles from crawling in. These protectors should be renewed before the egg-laying season of early summer. Lime-sulfur wash is a good protection against these beetles and this should be applied at least above these bands.

San José Scale.—This is one of the worst enemies of many kinds of fruit trees and ornamental plants. Large orchards were formerly destroyed by this enemy. The insects multiply very readily throughout the warm summer months and are checked only by cold weather. A very few in a garden or orchard in early spring may increase in such numbers as to destroy or seriously injure the growth of the trees before fall.

Remedies of several kinds are now known. If properly applied they will keep the scale in check and no serious damage will be done.

Soluble oil is on the market under different trade names. These are preparations in which the water and oil are caused to mix with each other readily by the use of certain chemicals. When these are used as sprays for San José scale they are applied in winter or very early spring before the leaves appear. Directions accompanying them should be followed carefully to avoid possible injury, as they vary in strength.

Lime-sulfur sprays are very successful in combating this insect. One application should be made in winter or early spring before the buds of the trees begin to swell and another in June or July before the young, tender insects cover themselves with the hard scale. The summer spray is made very weak to avoid injury to the leaves. Special directions should be carefully followed, as the strengths for winter and summer use are widely different.

Diseases, such as apple scab, peach scab, brown rot of peaches (Fig. 142) and others, are kept in control by the use of lime-sulfur when fighting the scale insect (Fig. 138).

Cut-worms.—Early spring gardens are often badly attacked by cut-worms. These larvæ work at night and eat the young plants off near the surface of the ground. They may be poisoned by sprinkling a bait around the plants. This is made of one teaspoonful of Paris green mixed with one quart of bran moistened with sweetened water. The worms may be found in early morning near the plants, just under the soil surface. Two other methods of control are suggested in figure 143.

Cabbage Worm.—This is the larva of the white cabbage butterfly. The eggs are laid on the leaves of cabbage at all stages of growth. The larvæ eat their way into the leaves and will ruin large numbers. Several common remedies are used. (See notes under cauliflower, Chapter XVI.)

Tomato Worm.—The large green tomato worm is the

Fig. 142.—Brown rot disease of peaches, plums and cherries often leaves dried-up mummies on the trees until next year. These are full of spores and will infest the next crop unless they are picked off in autumn or winter. (New Jersey Station.)

larva of the large sphinx moth. It attacks tobacco, tomato, egg-plant and a few other garden plants.

The best remedy is to spray plants when the insects begin their eating. Either Paris green or arsenate of lead may be used in about the same strength as for potato beetles. It is well to mix the poison with Bordeaux mixture as in spraying potatoes.

Potato Beetle.—This is not a "bug" but a true beetle. The larvæ do the most damage, but the adults also eat the leaves. One or two ounces of Paris green or one-half pound of arsenate of lead to ten gallons of water should be applied as early as the insects begin their work on the plants. The spray should be repeated every ten days or two weeks until the plants have nearly completed their growth.

If Bordeaux mixture is used in this spray instead of water, two objects are gained. The insects are kept in control better and the potato blight diseases are largely prevented.

Flea beetles are destructive on a number of garden plants. They are sometimes worse on potatoes than the potato beetles themselves. They also badly affect cucumbers and other vine

FIG. 143.—To protect from cut worms, rolls of paper or tin cans without bottoms may be left around tomatoes and other plants when transplanted to the garden.

plants, and frequently do great damage to egg-plants and others. Dusting with various materials, such as road dust, wood ashes, air slacked lime, or a mixture of these, will usually drive them away temporarily.

PLANT DISEASES.—In the notes regarding insects several plant diseases have been mentioned. Potato blight (Fig. 144) is a very serious disease which should be prevented. Tomato blight is sometimes quite serious in middle and southern states. Celery blight is very commonly so bad as to prevent the successful growth of the crop. Potato scab is probably the most serious disease of this group. Grain smut is a serious enemy of all small grains, particularly oats and wheat.

Remedies.—In Chapter XI suggestons are given for preventing potato scab and grain smut. In the preceding notes regarding insects directions have been given for the prevention of potato blight and tomato blight. Celery blight is prevented by the diligent use of Bordeaux mixture as a spray before the disease appears, or before it becomes generally spread through the garden. In combating any disease it is necessary to use

Fig. 144.—Potato with rot disease caused by late blight. (Productive Farm Crops.)

materials as *prevention* rather than *cure*. Bordeaux mixture is the standard preventive spray for nearly all fungous diseases of plants. Directions for preparing Bordeaux mixture are given in an exercise in this chapter. The strength for summer spray on tender plants is three pounds of copper sulfate (blue stone), four pounds of fresh lime to forty gallons of water. This strength is known as 3–4–40.

Sprayers.—The type of sprayer to use will depend largely upon the size of garden, the kind of crops, and whether there are fruit trees to be treated or not. The figures here shown

(145, 146, 147, and 148) should be studied before deciding what type or size to procure.

1. Preventing Grain Smut.—Soak a can full of oats for ten minutes in a solution made of one ounce of formalin (formaldehyde) in three gallons of water. Then pour off the liquid and dry the grain on a smooth floor. Seed which is thus treated should be planted in a row or small plot in the garden beside a similar area planted with seed of the same kind but not treated. As the crops come to head, any differences as to the amount of smut disease should be noticed and the proportion of smut, if any, in each case should be determined. This may be done by placing a ring of wire about a number of the plants and counting within the wire how many plants are diseased and how many are not. Figure the percentage in each case.

FIG. 145.—A type of sprayer called "atomizer," suitable for both young and old if the garden is not large.

Grain smut is of several kinds. The commonest form in oats appears in collections of black masses of spores on the heads before the grain is ripe (Fig. 149). This greatly reduces the yield of grain and affects the value of the grain produced. The treatment given in this exercise is simple and inexpensive. It usually prevents nearly all of the disease in the following crop. Stinking smut of wheat is a serious disease. Smut disease of any kind in the small grains may be prevented by the treatment of seed as given in this exercise. This method does not prevent the smut in corn.

2. Preventing Potato Scab.—Make a solution of formalin by placing one ounce of formalin (formaldehyde) in two gallons of

water. In this, place potatoes which are to be used as seed in the garden. For larger amounts of seed potatoes use the solution of the same strength. The liquid may be used over and over for a day or so until it loses strength by evaporation.

Potato scab is a serious disease in all potato growing sections (Fig. 150). Many seed potatoes which show none of the disease may have the spores upon them, by having been kept

Fig. 146.—A bucket sprayer, well suited to work in home gardens. (Fights of the Farmer.)

Fig. 147.—Knapsack sprayer, suitable for use in fighting garden pests. (Fights of the Farmer.)

with scabby potatoes. All seed potatoes before planting should be treated to avoid getting the disease into the field or garden.

Time to Spray.—Students should take apple and pear blossoms in different stages of development. Some may be in full blossom, others with the petals just fallen, and others with the green calyx leaves closing. These should be compared to see which are in right condition for spraying to fight codling-moth. After the petals close no spray can reach the nest where the little insect begins eating to enter the apple. If spraying is done before the petals fall many bees at work in pollinizing the blossoms for the future crop will be poisoned and killed.

Spray Calendar for Vegetables (Adapted from Ohio Bulletin 232 and Storr's Bulletin 56)

What to spray	For what to spray	With what to spray	When to spray: First spraying	Second spraying	Third spraying	Fourth spraying	Remarks and caution
ASPARAGUS....	Asparagus beetle	Air-slaked lime	When larvæ appear	Same as first	Same as first	Same as first	Do not use arsenicals, except in late Summer.
	Asparagus rust	Bordeaux	After cutting crop	Ten days later	Ten days later	Ten days later	Repeat 3 or 4 times. Burn rusted brush in Fall.
BEAN........	Anthracnose	Bordeaux	Soak seed 1 to 2 hrs. in am. cop. carb.	Bordeaux on 2 or 3-in. plants	Bordeaux 10 days later	After blossoms	Repeat if needed.
CABBAGE and CAULIFLOWER	Cabbage worm	Pyrethrum or Resin Lime	With 1st appearance of worms	Whenever worms are observed	Same as second	Same as second	One oz. to 30 gallons water.
	Aphis or louse	Kero. Emul. at the rate of 1 to 8	....	....	....	....	....
	Downy mildew	Bordeaux mix.	....	....	....	....	....
CELERY.......	Leaf spot or leaf blight	Bordeaux	On young seedlings	Repeat on seedlings	Before or after transplanting	Two weeks later	See footnote.
CUCUMBER....	Anthracnose	Bordeaux	When plants begin to vine	Two weeks later	Two weeks later	Two weeks later	Repeat as necessary.
	Downy mildew	Bordeaux	July 25 to Aug. 1	Eight to ten days later	Eight to nine days later	Eight days later	Repeat at weekly intervals.
	Cucumber beetle	Arsenate of lead in Bordeaux	Soon as plants appear	Week later	Week after second	Week after third	Week after fourth.
POTATOES.....	Early blight	Bordeaux	When plants are 6 in. high	Two weeks later	Two weeks later	Two weeks later	Seed selection desirable.
	Late blight	Bordeaux	July 15–20	Two weeks later	Two weeks later	Two weeks later	Repeat at two-week intervals until crop is mature.
	Blister beetle	Whale-oil soap	When beetles appear	Repeat if necessary	....	....	Use 1 lb. soap to 6 gal. of water.
	Colorado beetle	Arsenicals in Bordeaux	When beetles or young appear	As for first	As for first	....	Arsenate of lead, 3 lbs. to 50 gallons of water, for Colorado beetle alone.
	Flea beetle	Bordeaux or combined with arsenate	When beetles appear	Repeat if necessary	As for first and second		
TOMATO......	Anthracnose	Bordeaux	Soon after fruit begins to set	Three weeks later	Three weeks later		....
	Leaf blight	Bordeaux	Two weeks after transplanting	Three weeks after first	Three weeks later	Three weeks later	....

*NOTE—Keep leaves well covered in plant bed. Repeat every two weeks until celery is banked.

3. Spray Materials.—Make a collection of materials to be used in spraying. Samples of these will perhaps be available at nearby drug stores, or may be purchased from chemical companies which sell separate ingredients and mixtures. Care should be taken to label all very carefully and those which are poison should be sealed with wax or paraffine to make them more difficult to open. Certain mixtures, as kerosene emulsion, commercial lime-sulfur and others, should

FIG. 148.—An inexpensive spray pump with two leads of spray hose. More useful in the home orchard than in the garden. (New Jersey Station.)

also be shown in the collection. Other materials for the collection are arsenate of lead, Paris green, bisulfide of carbon, lime, flowers of sulfur and others.

Arsenate of lead may be dissolved for use at the rate of two or three pounds to fifty gallons of water. Bordeaux mixture or lime-sulfur mixture may take the place of the water as a combined insecticide and fungicide.

Paris green, used by the spray method, may be mixed at the rate of 8 to 16 ounces, and one pound of lime to fifty gallons of water. The extra lime is omitted if Bordeaux is used in place of water. When Paris green is used dry, one pound of it may be mixed with twenty pounds of powdered lime. This is used on plants when the leaves are moist with dew.

4. Making Bordeaux Mixture.—Slake a pound of lump lime, as described in another exercise. Add enough water to make five gallons. Dissolve a pound of copper sulfate (blue stone). This can be done by pouring hot water over it and stirring continuously for a few minutes. When hot water is not available the sulfate may be suspended in water by means of a cloth. This should be done the day before, as several hours are required. Add water to this solution to make up five gallons. When the Bordeaux mixture is wanted these two solutions should be poured together into a third vessel. The two should be poured at the same time; letting the stream of one meet the stream of the other in the air as they descend into the third vessel. Two persons can do this mixing better than one. The resulting mixture is of an intense blue color, but lighter in shade than the sulfate crystals.

FIG. 149.—The grain smut disease reduces the yield as shown on oats at the left. (Agriculture and Life.)

Bordeaux mixture is named from a town in France where the first experiments were tried with it. It should never be mixed until required for spraying, as it will not keep. The lime and sulfate may be dissolved separately and kept in stock solutions. It is a fungicide and not an insecticide when used alone. As a fungicide it should be applied as a spray before the disease starts on the plants. The above mixture would be called 1–1–10, which is equivalent to 4–4–40. This is strong enough for use on trees in their dormant condition. Weaker mixtures are used on garden plants and trees bearing leaves. Bordeaux mixture is very successful in the prevention of such diseases as apple scab, peach scab, potato blight, celery blight, tomato blight, cucumber and melon wilt and many others. In combining insect poisons with this mixture the poisons are used in the same quantities as when mixing them

Fig. 150.—Potato scab disease should be kept out of the soil by planting only such seed potatoes as have been treated with formalin as described. (U. S. D. A.)

with water. Such combinations are most economical as they are combined at the same time, and reduce the amount of labor. Two objects are accomplished in one operation.

5. Making Kerosene Emulsion.—Take one-half pound of hard soap, shave it very fine and dissolve in one gallon of boiling water. Add it, boiling hot, to two gallons of kerosene or crude petroleum away from the fire. The whole mixture is then stirred or pumped back into itself rapidly. After five minutes of rapid agitation the emulsion should be perfect and will have the consistency of cream. This is ready to be diluted as wanted for use.

Kerosene emulsion can be used successfully during the summer growing period for combating plant lice and other soft-bodied insects. Dilute the above emulsion with fifteen parts of water. This may be used either in the garden or on plants in hotbeds or windows. For the red spider and other plant mites which frequently affect house plants, add about one ounce of flowers of sulfur to one gallon of the diluted emulsion. It is used much stronger on scale insects and soft-bodied eating larvæ and larger plant bugs. About seven to ten parts of water will be weak enough. Emulsion is applied with a spray pump, using a very fine nozzle.

6. Making Concentrated Lime-Sulfur.—Use thirty pounds of powdered flowers of sulfur, fifteen pounds burned lime and fifteen gallons of water. Wet the sulfur and slake the lime. Add both of these to fifteen gallons of boiling water. Boil the mixture for forty to sixty minutes, or until well dissolved. This may be kept in a closed vessel until wanted. A layer of oil on top will keep out the air.

This is called home-made concentrated lime-sulfur. Its chief purpose is the fighting of San José scale and other scale insects. Be sure it is diluted with about nine times its volume of water for winter use on apple trees. The rule for dilution requires that the specific gravity of a liquid be found. Divide the decimal part of this number by three hundredths (.03) and the quotient will tell the number of times to dilute the liquid. For example, if this specific gravity equals 1.27, divide .27 by .03, giving 9. Then dilute the liquid with nine times its volume of water for winter use. As a summer spray on apples and potato vines it should be diluted with three times as much water as for winter use.

Instead of boiling lime-sulfur in an open kettle, as is done in the above plan, fruit growers and gardeners buy the lime-sulfur ready made. A number of commercial preparations of lime-sulfur are now sold. Each is supposed to be of about the strength given in this exercise. Directions for diluting the mixture are usually given with it.

7. Self-Boiled Lime-Sulfur.—Use eight pounds powdered sulfur and eight pounds of fresh burned lime with fifty gallons of water. The lime should be placed in a barrel and enough water poured on to almost cover it. As soon as the lime begins to slake the sulfur is added, after running it through a sieve to break up the lumps. Stir the mixture constantly and add more water to form at first a thick paste and then gradually a thin paste. This may require three or four gallons.

In the preparation of this mixture the heat from the slaking of the lime is enough to boil the mixture several minutes. More water may be added to cool the mixture and prevent further cooking. It is then ready to be strained into a spray barrel, diluted and used. The above mixture is called 8–8–50, and is used as a summer spray on peaches, plums and cherries. Trials of this mixture on potato vines have proved successful in the prevention of blight and the fighting of flea beetles.

Garden Friends.—When fighting the insects, we should feel some satisfaction in the fact that the garden has a number of friends in nature. Chief among these should be mentioned: (1) Such helpful insects as tiger beetles, ground beetles, some lady-bird beetles, insects that are parasitic upon others, such as Ichneumon fly, chalcis-fly, and others; (2) toads; (3) non-venomous snakes; (4) moles; (5) birds; (6) sometimes poultry; (7) lizards.

Beneficial Insects.—Young gardeners should learn to distinguish between the beneficial and the injurious insects. Some of the bulletins and books mentioned in Chapter XXIV will aid greatly in doing this.

Toads and Other Friends.—Insect-eating animals should be protected. Someone has said that a toad in a garden is worth twenty dollars to the gardener because of the many insects it will destroy. The toad begins feeding some time after sundown, searching for insects along roadsides, gardens, cultivated fields or other places where it may travel easily. They will destroy numerous cut-worms, army worms, caterpillars, moths, grasshoppers, crickets, beetles and other insects. Estimates have been made that in thirty days a single toad may destroy 720 cut-worms, 600 myriapods, 720 sow bugs, 1080 ants, 120 weevils, 120 beetles. (See Farmers' Bulletin 196.) Gardeners sometimes buy toads from collectors and colonize them in their gardens. A shallow pool of stagnant water is necessary during the spring breeding season if the toads are to be allowed to multiply. The tadpoles live in the water, and then develop into adults. Toads like to hide under stones, and old boards which may be left to form mulches around evergreens or other trees.

Birds.—Some birds are far more beneficial than others. We consider the insect eaters as the most helpful because they destroy such great numbers of insects either in the larva stage or in other stages. The seed-eating birds, however, are also beneficial because they destroy great numbers of weed seeds, and they often feed their young upon insects during the nesting season. Gardeners and others should protect the birds and encourage them to build their nests near the garden. Groups of shrubbery will attract some of them. Others will use boxes and bird houses put up for them. Attractive fruits, such as a Russian mulberry, a spice bush, wolfberry, barberry, hawthorne, wild cherry and others may be planted to help retain the birds more months in the year. By all means we should not allow hunters and marauders to kill or to frighten the birds away.

PART III—FOR CLUB LEADERS AND TEACHERS

CHAPTER XXI

AGRICULTURAL CONTESTS AND CLUB WORK

MUCH has been done in recent years in the organization of boys' and girls' clubs. Most of these clubs have been very successful in the work which they have undertaken. Local clubs are first formed. In hundreds of cases these have been organized into county clubs and a number of states have state-wide organizations.

Influence of Club Work.—Through their club work young people have been affected in many ways. They observe more closely and recognize good and bad qualities in crops they raise. Insects and plant diseases are studied more closely. The influence of soils, the effects of certain fertilizers and special methods of tillage are studied more carefully. Their views have been broadened by the reading of agricultural bulletins, and visiting the work of special schools, highly developed farms, and by visiting the work of their own competitors. Practically they have in many cases been able to decide which of the several lines they have undertaken will be most profitable commercially, and some have undertaken these commercial lines for themselves. Power of initiative has thus been developed (Fig. 151).

The value of organization and coöperation is brought out by the club work—the value of working together to a common end, as the development of a good strain of seed corn or poultry, or the coöperation in producing a uniform product for a special market demand. All these points and many others have been discovered in club work.

A secondary influence, and yet a vital one, is the effect upon the parents and other people of the community, where a club exists. This influence is always highly beneficial. Contests in growing corn and potatoes, or in baking, fruit canning and sewing have aroused interest on the part of the whole

FIG. 151.—Part of her crop saved for winter. These products were sold and the money used for education. (U. S. D. A.)

community in the work of young people (Fig. 152). The special lessons teaching improved methods, taken up by the young people, have been extended by them to others in the community. The child often leads the parent to follow better methods of production.

Lines of Work.—There is little uniformity in the lines of work followed by clubs in different localities. Many have carried on contests in corn growing (Fig. 153). A few have taken up tomato growing. Lettuce clubs, onion clubs, sugar beet clubs, potato clubs, sweet-potato clubs, alfalfa clubs, cot-

FIG. 152.—The rural school is a good place for the garden fair. The whole neighborhood may become interested. (Children's Flower Mission, Cleveland.)

ton clubs, pickle clubs, general vegetable garden clubs, home beautifying clubs, poultry and swine clubs—all these, and doubtless many others, are found in different localities, for both boys and girls. (See the contest list in this chapter.)

Special lines of work have been taken up by girls' clubs, such as cooking, bread making, canning, sewing and poultry raising.

Educational leaders and club workers continually emphasize the importance of having only *one idea* at a time in all work of this kind. They would say: "Stick to one thing, whether pigs or preserves, until an impression is made and real knowledge of the subject is gained."

How Organized.—The organization of boys' and girls' clubs depends upon the active interest of some teacher, principal or superintendent. When proper instruction has been given as to the purposes of the clubs, little effort is required to maintain the interest on the part of the members. Teachers who meet their pupils daily during the school year usually find that club work adds interest to the school work, and the net result is to make the instruction easier for the teacher. If the work is started by supervising principals or county superintendents, they must first gain the coöperation and interest on the part of teachers.

FIG. 153.—This 91-pound corn-club boy raised 91 bushels of corn per acre in Tennessee. (E. Thomae.)

A considerable amount of club work has been started by other organizations in no way connected with schools. Women's clubs, Y. M. C. A. Secretaries, rural churches, bankers' associations, commercial clubs, and other philanthropic organizations have all been influential in the starting of boys' and girls' clubs. Thousands of persons, in no way connected with such organizations, have aided the work by subscriptions, premiums, attendance and interest taken in meetings, home encouragement, and in other ways not always known to the public.

Incentives.—A number of methods of maintaining the interest of the members are found in use among the many clubs. Prizes are frequently offered. Photographs of work are taken, which are shown at school and public meetings. Lantern slides are sometimes made and shown at public lectures; club meetings are held, at which the work of members is discussed; essays read and reports of work are given; fairs are held showing products. These are often accompanied by lists of premiums awarded for superior work in each line.

Corn-growing Contests.—In different sections the rules for these contests vary according to local conditions. The following sets of rules may be adopted, or varied as desired:

Rules for Corn Growing Contests.—1. The contest is open to any boy in the county under twenty years of age on June 1st of this year.

2. Class No. 1 shall consist of boys (or girls) not over sixteen years of age. In this class the boys shall do all the work, except plowing and marking the ground.

3. Class No. 2 shall consist of those between sixteen and twenty years of age. This class shall do all the work themselves.

4. Applications are to be sent to the Secretary of the Committee (insert name and address), by April 15th. No applications will be received later than May 31st.

5. Contestants are to use seed supplied by the Committee (or are to secure their own seed). Each contestant will be provided with bulletins on corn growing from the county office. He is to keep a careful record of all details in the preparation of soil, application of fertilizer, cultivation, harvest, yield, and show the actual cost of producing the crop. A blank for this purpose is furnished. This report is to be sent with the exhibit in competing for prizes.

6. Contestants are to exhibit ten selected ears at the annual corn show which will be held. (Insert place and date.)

7. Certificates of merit will be awarded every contestant who exhibits corn which reaches a high standard to be determined by the judges.

8. The Committee reserves the right to make any changes in the list of prizes which may be advisable.

9. Corn winning the first and second prizes may become the property of the Committee.

Application Blank for Boys.—I desire to enter the Corn Growing Contest to be conducted by the Committee, and agree to be governed by the rules of same.

Name.. Age..........
Father's Name ....
Address ....
Name of School ....
Teacher's Name ....
Direction from nearest railroad station or trolley line..............
....

School and Club Fairs.—Work is done along all the lines suggested above, or in lines in which the club is interested. For the sake of uniformity of exhibits, or so that the products may be grouped well for comparison with each other, it is best to issue lists for the members to follow in selecting their material for the fair. These lists are not necessarily accompanied by prizes, but some competition may be aroused by the offer of certificates, ribbons or cards of honorable mention to those excelling in each competition.

Suitable Time and Place.—Schools may hold these fairs any time during the fall. If the exhibit is to be held at the church, it may come in connection with some church festival, such as anniversaries. The Thanksgiving season is a very profitable time for either schools or country churches to have exhibits of products of club work. If farmers' exhibits are held during the fall or winter, the products may be shown then. If the club fairs are made a special feature of an annual farmers' exhibit, they will add much interest to the meetings.

The country fair often occurs too early for some of the products, such as corn, but garden products, flowers and the household work of girls should be shown at the county fairs, district fairs and state fairs (Fig. 154). It is never difficult to find suitable places for holding the exhibits. Granges are willing to have open sessions for this purpose, or to supply their halls for the display of products.

Clubs have found it possible, in some cases, to charge admission to the fairs, thus obtaining funds to defray expenses. Materials used for local fairs may be saved by exhibit committees, or by the individual exhibitors for use at district fairs, county fairs or state fairs. Suitable programs are often given in connection with school or club fairs. Such a program may be made up of essays written in competition, telling the best methods of growing crops, or making certain articles for the fair. Reports are given of the methods used by the

FIG. 154.—Mounted plants, insect collections, cut flowers, manual training, wall maps, and pictures are here combined with school garden exhibit. Kentville, Nova Scotia. (School Garden Association of America.)

different members. Suitable lantern slides of school and home garden work, or club work in other places, may be obtained from the United States Department of Agriculture, state agricultural colleges, local schools, or from other more local sources. Music may be provided. The judging and awarding of prizes or certificates of merit may be announced publicly. Plans for future work may be outlined.

Contest Lists.—For the purpose of making the fair exhibits along definite lines, the field to be covered should be studied by the fair committees and suitable lists published, or announced in advance. A few suggestions along these lines are gathered here from contests held in different localities.

A prize may be offered for the largest yield from 300 kernels of corn furnished to each child. In garden contests latitude should be allowed; for example, one dollar may be offered for the best sample of any vegetable or any field crop. Best collections should also be included. Children under ten years of age may be rewarded separately from girls over ten or from boys over ten.

In the Boys' and Girls' Clubs in Kansas the following lines of competition were open:

Corn.—(1) Best ten ears from corn grown on an acre. (2) Highest yield from a single acre.

Kafir or Milo.—(1) Best ten heads from single acre. (2) Highest yield from single acre.

Broom Corn.—Best ten heads from single acre.

Potatoes.—(1) Best peck from plot 50 × 50 feet. (2) Highest yield from one-half acre.

Tomatoes.—(1) Best three cans from plot of one square rod. (2) Most pounds of all ripe and green tomatoes gathered up to time of first killing frost.

Family Garden.—Best display of vegetables from plot 24 × 24 square feet.

Poultry.—Best trio of birds.

Pig.—Best fat pig in the six-months' class.

Bread Making.—Best loaf in regulation pan.

Butter Making.—Best pound of home-made butter.

Jelly Making.—Best exhibit of five different varieties in glasses.

Canned Fruit.—Best three different varieties in glass cans.

Sewing.—(1) Aprons entirely hand made. (2) Work apron, hand and machine made. (3) Mending, darning, patching, and piecing. (4) Sample of table linen making and mending (hand work). (5) Shirt waist, hand or machine made.

Corn.—Premium lists for corn are given in a special chapter on corn. Ten ears are usually required for an exhibit. These are in white varieties, yellow varieties and in both dent type and flint type.

Potatoes.—The lists for potato exhibits should include the leading varieties grown in the neighborhood, letting each variety be kept separate. These may be exhibited on plates, as apples are shown, or the list may require the showing of a basket of each, the baskets being of the standard commercial size for that region, say half bushel. The points of excellence for potatoes are uniformity, size, smoothness, texture, freedom from blemish and disease. The value for each of these points is shown in the score card given in this chapter.

Sweet Potatoes are usually shown in commercial baskets. These may be half bushel baskets, half bushel crates, or any special form of package used in the locality. White or green crepe paper may be used in dressing the edges and outside surface of the packages uniformly throughout the exhibit. The type or variety of sweet potatoes should be kept distinct, and may be listed separately with premiums or awards for each type or variety. The white, red and yellow crops should not compete with each other.

Sugar beets may be exhibited by varieties and types commonly grown. Five beets of a kind may constitute an exhibit. In some cases 100 pounds is required to make up the exhibit. The tops are usually removed and the roots washed.

Tomatoes are of many varieties and each variety should stand on its own merits at the fair. Some are better suited for market purposes because of firmness, while others are of high quality, and better for home use, being too tender for shipment. The list may include from five to ten varieties most grown in the vicinity. Tomatoes are exhibited both on plates and in baskets or other commercial packages, but the list should stipulate the style to be followed at the fair.

Onions.—The season of the year for holding the fair may help to govern the list of onions. Green onions should not be included if they are not in season. The leading varieties and types of ripe onions should be kept distinct; the yellow, red and white are different types and should not compete for the same awards. Let them all be shown separately. Small pickling onions, onion sets and multiplier onions may be included after the list of standard varieties. Onions may be shown in small baskets holding about one peck, if such packages are standard in local markets.

Cucumbers may be exhibited in the different sizes required for various kinds of pickles. They may also be shown in preserved condition as sweet, sour and brine pickles. Those of different varieties may also be listed separately. Pickles should be shown in quart glass jars and the fresh cucumbers in baskets, holding one peck or less.

Lettuce may be grouped into three main types: (1) head lettuce, (2) loose, or curly lettuce, and (3) cos, or Romaine lettuce. Flat trays or flat baskets are best suited for the exhibition of lettuce. To keep it fresh during the exhibit it is sometimes placed in flat boxes in the bottom of which are placed pans of water.

Garden vegetables of all kinds may be classified on the essential manner of growth or purpose for which they are grown. Prizes may be offered for the best collection of each of the following: (1) Root crops, including beets, carrots, parsnips, radishes, salsify, turnips, rutabaga; (2) cole crops, including cabbage, cauliflower, and kohl-rabi; (3) pot-herbs for greens, including spinach, beet and dandelion; (4) salad plants, including celery, parsley, endive and lettuce; (5) legume or pulse, including peas and the different types of beans; (6) plants of the potato family, including tomato, egg-plant and pepper; (7) vine groups, including muskmelon, watermelon, squash, pumpkin, cucumber and gourd; (8) sweet corn; (9) perennial vegetables—asparagus and rhubarb; (10) sweet herbs, including sage, thyme and others.

In any list these groups may be greatly subdivided, and special awards made for each kind in any group.

Collections of vegetables, including all grown in any school or home garden, may be given a place in the list, but such collections do not alone make up a good exhibit at a fair. Giving them a special place in the list will lend encouragement to the small children in the school and home garden work. Very large numbers of kinds of varieties are sometimes gathered together, because of special premiums given for large collections. These may be divided into two groups, annual vegetables and perennial vegetables, the latter including rhubarb, asparagus, sweet herbs and others.

Farm Products.—In the lists for some local fairs premiums have been offered for the largest collection of farm products of all kinds, including those from the garden, field, piggery, poultry yard and others. At one fair a single exhibitor showed 167 varieties of farm products. These included many things prepared in different ways for table use (Fig. 155).

Alfalfa and other legumes, such as clovers, may be listed and prizes offered for the tallest bundles of each kind, each bunch to be six inches through at the band. The best individual plants showing large roots and many stems are sometimes listed. Offers may be made for the best collections of legume roots with nodules. This latter adds much interest to the exhibit.

Cotton is a plant which is subject to great improvement, and should never be omitted from fairs in sections where it is grown. In the fall, single plants may be shown to teach the best forms of plants. Those with great numbers of bolls on thrifty plants on nodes or joints should be shown. The cotton yields of individual plants may be a feature. The proportion of seed found in a pound of unginned cotton and the length of staple must not be forgotten. If several types of cotton are grown in any locality, these should be listed separately. The best collection of cotton diseases and insects, showing the work of each, is sometimes included.

Fruits are among the most beautiful products for use at fairs. Apples may be shown in the form of bushel boxes, so

FIG. 155.—A mountaineer's family having a home canning demonstration of their own. They have learned how to save summer's plenty for winter's use. (U. S. D. A.)

popular in the West and city markets. They may also be shown in peck baskets or on plates. They also make a fine showing in the small cartons, or "gift boxes," which have become very popular in city markets.

Grapes are usually shown in collections on plates. Peaches, plums, berries and other fruits should be included in the list, if the season is favorable for them.

Annual flowers add much interest to both the garden work and to exhibits. Offers may be made for the best bouquet of each of five different popular flowers. Mixed bouquets should not be encouraged. Collections of bouquets of not less than one dozen flowers each are far better. Plants in blossom may be transplanted and shown, and the list should encourage such exhibits.

Perennial flowers, including roses and any others which may be found suitable to the season when the fair is held, should be exhibited. Young people take great delight in flower gardening, and many homes are greatly beautified by the planting of hardy perennial plants which blossom throughout the season. Fair lists may include each of the kinds separately, and where certain varieties are popular special offers may be made for those.

Window Flowers.—Offers for the best collection of foliage plants, such as ferns in wooden boxes or pots, should be included in the list; also plants in blossom; bedding out plants in pots or boxes, such as coleus, vinca and others. Plants in this group need not be potted uniformly, but may be in any form of cans, boxes or pots used in homes or school windows. They may be given a better appearance by having them wrapped with a uniform color of crepe paper or other material.

Home Beautifying.—A fair committee should offer to take photographs freely for all who enter either at the beginning of the season or in late summer, for competition in the improvement of the home or school grounds. Photographs can then be shown at the fair accompanied by the name of the competitor in each case. When entries are made early in the season, "before and after" effects should be shown in the pictures. A few of the points to be considered in the competition are: (1) The greatest improvement in a home back yard; (2) the same for a front yard; (3) the same for any rural school grounds; (4) best display of annual vines in the

interest to the fair. Canning devices may be entered with much profit to the visitors. Many home devices and plans may be shown directly or by pictures. Fruits or vegetables kept by means of unwholesome preservatives should not be considered. Entries should be judged on the basis of clearness, natural color, natural form and freedom from mold or other signs of deterioration. Uniformity of exhibit, labelling and size of package may be considered.

School Competitions.—County and district fairs fre-

FIG. 156.—The canning club work leads to home canning of fruits and vegetables. The products may be either sold or used in the home. (U. S. D. A.)

quently offer prizes to arouse competition between different schools. Village or graded schools are allowed to compete with each other, and district schools form a different group. Lines in which schools compete are: (1) The best school garden. (2) The best average yields of various products. (3) Collection of vegetables shown. (4) Collection of flowers shown. (5) Greatest number of prizes won by members in the individual contests. (6) Best collections of various articles used for school work mentioned in the following paragraph.

Prizes won by schools may be owned by the school as a whole or by the grade or department deserving the credit. If the prize be cash, it may be used to promote the garden work.

School Collections.—Individual prizes are sometimes offered for special collections suitable for use in school, such as, (1) collections of grains and seeds in uniform bottles, (2) weed seeds in bottles properly labelled, (3) roots of legumes showing nodules, (4) garden insects, (5) samples of plant diseases mounted on cards and labelled, (6) collection of woods showing grain on end and side, (7) mounted specimens of wild flowers properly named, (8) garden and field weeds mounted and labelled, (9) bottles and materials showing the composition of various human foods and animal feeds, such as corn, eggs and potatoes.

Such collections in the fair will arouse much interest.

Commercial Packages.—In the school and club fair work it is best to have as many of the products as possible shown in packages of commercial size, and the best forms of packages for each line of product should be chosen. Uniformity of package in each line is very desirable and will make the exhibits much more attractive. Articles shown without carriers or containers should be tied with ribbons or colored tape into bundles or groups. Ten ears of corn tied with colored tape will show much better in a large collection than if laid flat. Figure 154 shows how some articles have been displayed.

Decoration.—Exhibit committees and superintendents of exhibits should have supplies of colored paper or cheap cloth for considerable decoration of all packages as they are brought to the fair. Tables should be covered with plain wrapping paper or other cheap material, and the sides of the tables draped with colored goods. Walls and tables may all be

and indeed almost any product of field or garden. These crops may be grown by young people at their homes in connection with school work, club work, or in the "part time method" of agricultural education, in which credit is given at school for work done out of school.

Yield contests require attention on the part of some one in charge to ascertain carefully the areas and yields. Mere statements on the part of the contestants should be verified by a special committee without prejudice. The actual width and length of areas planted must be known. From this the area in square rods or fraction of an acre must be determined. Yields may be expressed in either weight or measure, but in every case the method of determining yield should be the same. With corn yields the product may be measured after husking, but in other cases the corn is allowed to become dry enough to keep in a crib before it is weighed or measured. Measuring the yield of corn, for example, is more practical than weighing it, as many farms do not have proper scales. In measuring corn a bushel basket, shaken down and very slightly heaped, is used as a unit of measurement. For each crop the method to be followed in determining the yield must be stated in advance; condition of crop, time, manner, size of yield and all other details must be included. The same committee that is to determine the yield should also determine the area. This means considerable work on the part of a few unbiased persons. The work may be lightened by dividing it up among the members of a large committee.

Score Cards for Contests.—So far as possible the form to be used in the judging of products should be published with the premium lists. This is possible in cases of such products as corn, potatoes, sweet potatoes, apples, bread, tomatoes, sugar beets, cotton and others. A few score cards with brief explanations are given here. A suitable score card for corn will be found in the special chapter on corn.

Score Card for Sweet Potatoes

	Counts
Size—2″ to $3\frac{1}{2}$″ diameter. Too large, cut 2; too small, cut 12.. Sample not uniform, cut 6.	20
Shape—Diameter half the length, or to suit variety............	20
Color—Clear, uniform, to suit variety, internal and external....	20
Texture of Skin—Clean, smooth with no cloudy appearance......	10
Texture of Flesh—Firm and even, not fibrous nor watery......	10
Freedom from Disease—No indication of black-, stem-, or ground-rot	20
Total	100

Bread Score Card

	Counts
Flavor	35
Lightness	15
Grain and Texture	20
Crust	10
Crumb	10
Shape and Size	10
Total	100

Size of pan recommended, $7\frac{1}{2} \times 3\frac{1}{2} \times 2\frac{3}{4}$ inches.

The flavor should be sweet and nutty, with no trace of sourness.

The loaf should be light, showing it has raised properly—with fine, even grain and tender yet elastic to the touch.

The crust should be a rich, even brown, fine and tender and not too deep.

The crumb should be creamy in color—not grayish—and moist without being heavy or underdone.

The loaf should be even in shape and not too large to insure thorough baking.

Judging Tomatoes.—Tomatoes exhibited at fairs should be entered under one of three heads: for trucking, for home use, or for canning. The purpose for which each is intended may be indicated on a card placed with the exhibit.

The following score card indicates in the three different columns the credits to be given for each of the purposes named.

production of the crop, the hours and value of hand and horse labor on each, date, value of fertilizer, rent of land, effects of insect enemies and diseases, cost of spraying and all other elements involved in the cost of production.

The best time to make the records is from day to day as the operations are performed. Do not leave the blanks unfilled until the end of the season and then try to fill them from memory. The accompanying form for use in boys' corn club work is adapted from that used in the state of Iowa.

How to Use Records.—After young people have kept records on some form provided for the purpose it is not enough to merely have them filed in the teacher's desk or the superin-

Pupil's Record for Lettuce

School........................ Pupil........................

Teacher......................

Date of Sowing	1st Sowing	2nd Sowing
Dates of Cultivating and Weeding		
Dates of Thinning and Transplanting		
Date of Applying Nitrate of Soda		
First Date of Using Heads or Bunches		
Time Required to Grow Large Heads		

Remarks.—On weather conditions, difficulties, the effects of fertilizing, effects of thinning and of transplanting. Write on the other side.

tendent's office. More use should be made of them. Let some committee go over the records for any single crop and collect suitable data and record cost. Notable points on individual records should be read at a club meeting or the fair. Several of the most complete reports should be read by the members themselves. In many cases essays or written reports are gleaned from these tabular forms. Exercise in expression is thus gained.

Data gleaned from the reports showing cost of production may form the basis for arithmetic work in schools.

The records showing greatest economy in cost of production should be discussed by some older person and much value may be gained not only for the members themselves, but for older people attending the meeting. The discussion of these reports in a public meeting, at school or the fair will lead parents and others to see the value of keeping records. A form used in the club work in Ontario and elsewhere is here shown.

Potato Score Card

(*Agronomy Department, University of Maine*)

Variety ....Date ....Name ....

	Counts
1. *General Appearance.*—In general appearance the potato should show a brightness and freshness. It should be of desirable size to meet the requirements of the market. In shape the flat, oval type is most in favor on the market...........	20
Size, 5. Uniformity in size, 5. Freshness, 5. Shape, 5.	
2. *Trueness to Type.*—Different varieties of potatoes, like the different breeds of cattle, have their own distinctive types. The size, shape, color, and skin-texture of the sample will be determined by the variety. The most popular color on the market, at present, is white. For economy of substance the potato eyes should not be deep................	25
Size, 5. Shape, 6. Color, 5. Skin Texture, 4, Depth of Eyes, 5.	

Packing: Bulge or swells, 5; alignment, 4; height at ends, 5; compactness, 8; attractiveness and style of pack, 8; total, 30; grand total, 100.

Fancy Baskets of Fruit.—Prizes are sometimes offered for mixed fruits arranged in fancy baskets, such as are sold in the markets for gifts or lunches. In judging such collections consider the following points: Arrangement, 30; quality of varieties, 20; number of kinds, 20; attractiveness of basket and contents, 30; total, 100.

Grape Exhibits.—Grapes are often displayed on plates, not less than three bunches to the plate, except when the clusters are very large. The following points should be considered in judging: Flavor, 15; form of bunch, 20; size of bunch, 15; size of berry, 10; color, 10; firmness, 5; bloom, 5; freedom from blemishes, 20; total, 100.

Plums and Peaches.—These fruits may be displayed on plates, not less than five specimens to the plate. They are also displayed in quart fruit boxes and in small baskets. The points to be considered are, for plums: Form, 10; size, 15; color, 15; uniformity, 20; quality, 20; freedom from blemishes, 20; total, 100.

For peaches: Form, 15; size, 10; color, 15; uniformity, 20; quality, 20; freedom from blemishes, 20; total, 100.

Vegetable Displays.—When offers are made for the largest collection of vegetables from a school or home garden, the following points should be considered: Size of collection (kinds), 25; number and value of varieties, 15; educational value and attractiveness of arrangement, 30; quality of vegetables, 30; total, 100.

Some standard may be set as to the number of specimens and the counts which may be given to each kind of vegetable in the collection. The following is suggested by Prof. M. A. Blake of the New Jersey Station:

Score Card for Vegetable Displays

		Counts
Beans, Green or Wax	20 pods	5
Beans, Lima	20 pods	6
Beets	6 specimens	6
Brussels Sprouts	20 heads	8
Cabbage	2 heads	7
Cauliflower	2 heads	10
Carrots	10 specimens	6
Celery	3 stalks	10
Cucumbers	6 specimens	7
Corn, Sweet (marketable)	6 ears	10
Egg Plant	3 specimens	8
Endive (bleached)	4 heads	8
Horseradish	2 bunches	5
Kale	3 plants	5
Kohl-rabi	6 specimens	6
Leeks	3 specimens	8
Lettuce	4 heads	9
Muskmelon	3 specimens	10
Okra	12 specimens	5
Onion	12 specimens	9
Onion Sets	2 quarts	7
Parsley	1 bunch, 6″ in diameter at top.	6
Parsnips	6 specimens	7
Peas	20 pods	8
Peppers, Standard	5 specimens	6
Peppers, Small Types	10 specimens	5
Potatoes, Irish	10 specimens	6
Potatoes, Sweet	10 specimens	7
Pumpkins	2 specimens	7
Radishes	18 specimens	4
Rutabagas	6 specimens	5
Salsify	12 specimens	6
Squash, Large	2 specimens	8
Squash, Small, Bush, Cocoanut	4 specimens	5
Tomatoes, Standard	5 specimens	7
Tomatoes, Plum and Cherry Type	15 specimens	6
Tomatoes Currant Type	30 specimens	4
Turnips	6 specimens	5
Watermelon	2 specimens	8

CHAPTER XXII

CORRELATION WITH OTHER SCHOOL WORK

An objection to school and home gardening by young people is made on the ground that other lines of school work occupy the whole time. Teachers and parents too frequently decide that older lines of school work must be maintained and that gardening can have no place in the school program and the time of young people cannot be devoted to such work when there are other "lessons" to learn. Teachers, school boards and committees that have successfully carried on gardening in connection with other lines of school work are ready to answer these objections by describing how well the gardening helps the other lines of work. Numerous examples of this are found wherever trials have been made.

Effect of Interest.—Any teacher who has planned the gardening well and put the pupils to work will testify to the interest taken by a large majority of the members of the school (Fig. 157). The interest aroused is enough to make the other lines of school work much easier than before. The value of any school work depends not so much upon the subject taught as upon the interest taken in the subject. Teachers are familiar with the loss of time and energy in trying to train pupils who seem dull in certain subjects. The subjects disliked by such pupils should be correlated with the garden work. The interest in gardening will lead to better work in the subjects formerly disliked. The use of interesting subjects will strengthen the weaker parts of the daily program through correlation.

Getting Started.—(1) Window gardening offers one of the best means of beginning this new work. (2) Pupils who show the greatest advance in other lines of school work and are "ahead of the class" may be allowed to start experiments outlined in this book and in farmers' bulletins. (3) Out-door gardening may be used as an incentive to classes for the completion of the other work. Teachers may plan with the pupils how much of a subject is to be learned in a certain week. If this work is well done in four days, the lesson time on the fifth day may be used in the garden. (4) Some teachers use a "credit mark" system and allow pupils a certain length of

FIG. 157.—A nature study lesson in the garden. Insects and plant diseases may best be studied in gardens. (Illinois Normal University, Normal, Illinois.)

time in the garden for a given number of credit marks earned in the other school work. (5) Instead of having special literary programs Friday afternoons throughout the year, as practiced in some schools, the time is used in the garden during the spring and fall seasons. (6) Some teachers have found the interest in the beautifying of the school grounds great enough to cause the pupils to use much of their recreation time in the planting work. This may be objectionable in the minds of some, but the real difference between work and play is in the interest taken. The "game" of cleaning up the grounds may be enjoyed by all, also the games of planning, planting, cultivation, trimming, spraying and others.

Arranging the Program.—Teachers, principals and superintendents who are willing to place school gardening on the daily program will have no trouble in finding room for it. The most serious difficulty in placing gardening on the daily program is found by teachers who do not have an interest in such work. As the interest grows, more room for the subject will be easily found.

A very satisfactory plan is to give the subject a place on the program only during the fall and spring terms, or perhaps only during the spring term. A very good plan adopted in some schools is to let the subject alternate with other regular school subjects; for example, gardening will occupy the place of arithmetic on Monday, the place of language on Tuesday, the place of reading on Wednesday, the place of geography on Thursday and the place of history on Friday. By this arrangement the work of any one subject of the program is not seriously reduced, and yet the gardening is given a place daily throughout any term in which such a plan is followed. If objection to this is made, it is answered on the ground of correlation—that is, the garden work is so related to each of the other subjects as to be fully equal to it, not only in practical training but in actual training along the same line. The gardening work will actually give training in arithmetic, in language, in reading, in geography and in history. In all the correlation work the subject must be changed often enough to avoid any loss of interest, which might come from constant repeating.

Arithmetic.—Training in arithmetic depends very largely upon the right conception of the problems involved. Abstract reasoning, beyond mere number conception, is not a part of true arithmetic. It belongs to higher mathematics. The child must first understand the meaning of a problem before he can solve it. The manipulation of numbers in an arithmetical problem does not train powers of reason and understanding. Problems in arithmetics are too frequently concerned with matters beyond the child's experience and knowledge. It is far better to have the problems of a practical nature regarding the things at hand. They should deal with the experiences of the child. Gardening opens wide the door for the introduction of such problems. Students working with statements, the meaning of which they can understand, will learn operations and arithmetical principles much more rapidly than when they are puzzling over problems which are beyond their conception. Experiments, such as seed testing, form a better basis for practice in percentage than do the imaginary stocks and bonds of older people.

A great difficulty in the use of practical garden problems is that many of the text books on arithmetic cannot be so closely followed. If such texts are used to teach methods of proportion, miscellaneous problems to illustrate it may be devised by both teacher and pupils. When a few sets of such practical problems have been formulated, they may be used to much better advantage, and the principles of arithmetic will be learned in less than half the time formerly required. Thus the teacher of the school finds the pupils learn more in arithmetic through the school garden plan in shorter time than by the old plan. The teacher of arithmetic who has experienced such results will not say that there is not room for school gardening.

Suggestive Problems.—The following are a few arithmetic problems, based on the school garden work. Many others may be made up by teachers, and even by students themselves.

1. Bordeaux mixture may be made up of 4 pounds of copper sulfate, 4 pounds of lime and 40 gallons of water. The lime may be valued at one cent a pound and the sulfate at 4 cents a pound. If 20 gallons of the mixture are required for spraying one-eighth of an acre of potatoes, what is the cost of the material for this purpose?

2. Suppose two applications of this spray material are required to prevent potato blight, and each application costs 50 cents for labor. What is the total cost in fighting the blight?

3. How many bushels of potatoes, valued at 60 cents per bushel, will it take to pay for the cost of fighting the blight?

4. One gardener prevents blight by spraying, and his yield is 25 bushels on one-eighth acre; another gardener neglects his crop and gets but 12 bushels from the same area. What is the profit due to spraying, when potatoes sell at 85 cents per bushel?

5. If a field kept clear of weeds produce 75 bushels of corn per acre, and a weedy one only 45 bushels per acre, what is the money loss caused by weeds, when corn sells at 55 cents per bushel? What would be the loss on a ten-acre field at the same rate?

6. If tomato plants are set three feet apart in the rows, and the rows are three feet apart, how many plants will be required to set one acre? (An acre equals 43,560 square feet.)

7 If one man can set three plants in one minute, how long will it take two men to plant one acre?

8. If the plants cost 25 cents per hundred, and the men are each paid 20 cents per hour, what will be the cost of planting one acre of tomatoes?

9. If 20 per cent of the plants die, how many will remain in the field? How many will be required to replant in the vacant places?

10. If the plants each yield one-fourth of a bushel of tomatoes, what will be the total crop in bushels? In pounds? In tons? (Consider 60 pounds to the bushel.)

11. If these bring 40 cents per bushel in the market, what will be the value of the crop?

12. If it costs $2 for plowing, $2 for harrowing and cultivating, $12 for fertilizing, and $4 for spraying the acre of tomatoes; five cents per bushel to harvest, and five cents per bushel to market the crop, what will be the cost per bushel in raising tomatoes?

13. What will be the profit per bushel? Profit per acre?

14. If the value of garden vegetables raised on one "vacant" tract, 50 × 150 feet, amounts to $42, what will be the total value of vegetables raised on 250 such lots?

15. What will be the total area in acres of this number of lots?

16. If sweet corn is planted in rows 3½ feet apart, and the stalks 18 inches apart in the rows, and each stalk yields two marketable ears, how many ears can be raised on one vacant lot, 50 × 150 feet?

17. At 15 cents per dozen, what will the crop be worth?

18. If one boy can care for three such vacant lots, and works an average of twelve days on each lot, how much will he earn during the summer? How much for each day he worked?

19. A large back yard worked by two brothers yielded how much cash when the sales were made up of the following? Beets, $13.75;

tomatoes, $6.82; lettuce, $11.75; tomato plants, $2.70; corn, 72 cents; carrots, 30 cents; radishes, $16.80; onions, $2.23; peppers, $1.35; spinach, $1.37; green beans, $1.34; wax beans, $1.11; celery, $35.30; strawberries, $1.65; peas, 95 cents; cabbage, 55 cents; lima beans, $1.30; stalks, 25 cents.

20. The family used vegetables of the following values: Lettuce, $4.95; radishes, 49 cents; spinach, 38 cents; corn, $6.40; rhubarb, 35 cents; tomatoes, $14.89; peas, $2.04; strawberries, $5.93; beets, 90 cents; green beans, 38 cents; celery, $1.17; peppers, 25 cents; potatoes, $1.50; onions, 25 cents; Lima beans, 93 cents; squashes, 37 cents; carrots, 3 cents; cucumbers, 15 cents; cabbage, 10 cents; egg-plants, 34 cents; parsnips, 60 cents. What was the total used? What was the total sold and used?

21. If 25 per cent was spent for fertilizer, seed and plants, what was the net income from the garden?

22. If the income for sweet corn from three city lots, each 50 × 100 feet, is $90, what would be the income per acre?

23. If 10 per cent is spent for seed and fertilizer and 25 per cent for labor, what is the net profit per acre?

24. A crop of lettuce on a lot 50 × 100 feet contains 2500 plants which sell at an average of 4 cents each, what is the value of the total crop? What is the net profit if the cash outlay for fertilizer and seed is $8?

25. The yield is increased by irrigation so that the heads sell for 7 cents each. What is the profit due to irrigation, if the cost of irrigation is $10?

26. What fraction of an acre is in a garden which measures 60 by 42 yards? 210 by 105 feet?

27. Give suitable dimensions for a garden which is to contain one-eighth acre. (43,560 sq. ft. per acre.)

28. How many stalks of sweet corn on one-tenth acre if its rows are three feet apart and the stalks average one foot apart in the rows?

29. If each stalk yields one good roasting ear, and ears sell at 10 cents per dozen, what would be the income from one acre?

30. If potatoes are planted these same distances, how many bushels will be produced per acre if thirty-five plants yield one bushel?

31. With potatoes selling at 40 cents per bushel, what would be the income from one-tenth acre?

32. What is the income from one-twentieth of an acre of head lettuce, plants growing at distances 1 by 2½ feet, and selling at 3 cents a head?

33. At Winthrop College there were 150 school gardens, each 9 by 24 feet. What was the acreage in all?

34. Between these rows of gardens are paths three feet wide (running the long way). The cross paths are two feet wide. What is the total amount of land required for the 150 gardens?

35. What is the area of all the paths in the above tract?

36. Get prices of seeds and calculate the total cost of seeds for a half-acre garden with such crops as indicated in the garden plan, not including the bush fruits and perennial plants.

37. Calculate the income for each crop as indicated in problems 3, 4, 5, and 6.

38. Calculate the cost of production, allowing $4 per acre for manure or other fertilizer, $3 for plowing and harrowing one acre, $3 for horse cultivation for the season on the half-acre, $10 for planting and hoeing, and $25 for harvesting and marketing. (Change these estimates, if possible, to suit your locality and season.)

39. If the crop of potatoes mentioned in problems 5 and 6 is half lost by attacks of potato beetles, because of not spraying, what would have been the profit from spraying to kill the beetles, at a cost of $1.50 each for three applications?

40. Tomato plants can be staked and tied up for about 2 cents each. What would have to be the increased returns on one-tenth acre to double this cost, if the plants are at distances 3 by 3 feet?

41. Water pipes with nozzles 3½ feet apart, mounted on posts 7 feet above the ground, may be made to irrigate a plot 25 feet on each side, or 50 feet wide. If two such pipes are used how long should they be to irrigate one-half acre? What would they cost at 5 cents per foot?

42. How many nozzles would be required? What would they cost at 5 cents each?

43. If the posts are placed one rod apart in each line, how many would be required in the two lines? What would they cost at 25 cents each?

44. What will it cost to dig the holes and set the posts, if a laborer can do 25 in one day and he gets $1.25 per day?

45. What will it cost to drill the holes in the pipe and screw in the nozzles, if a laborer can do one every six minutes, and works ten hours for $1.25?

46. Allowing $1.25 for valves, $3.50 for strainer unions, $2 for labor not included in the five preceding problems, and $75 for pump and gasoline engine, what is the total cost of the equipment for irrigating one-half acre?

Language.—Too frequently in some schools the language work consists in the learning of rules of proper speech and proper writing. How to talk and how to write are both better learned by good practice. The rules, of course, are also important. It is very necessary when young people are receiving their training in language work for them to have something suitable about which to talk and write. Every-day things form the best subjects for such practice. Many of the every-day things soon become old to the child and newer things must be taken up. Right here the garden work fills the need. With new things to tell and new lessons to consider, young people will never lack for interesting subjects in language work. Let the children tell of their experiences in testing corn. Let them tell of the reasons for certain samples being better than others, the advantages of certain methods, reasons for their choice of certain vegetables to plant, methods which they have followed during the garden season, enemies which they found and how they combated them, and a hundred other subjects.

Language based on garden work may be both oral and written. When pupils are asked to write essays they will prefer subjects about which they have been working. They will write much better than if their subjects related to foreign lands and vague things. Essays or descriptions based on garden work will come spontaneously; the language will be their own and not that of some author.

Incidental knowledge is gained when language work is based on practical things. The child is not only taught to speak and write, but to learn something else at the same time. Thus language is not in itself an abstract thing. It is closely linked with the doings of the child and with his environment (Fig. 158). Correct speech and correct writing expressions are gained more readily when based upon real rather than visionary things.

Reading.—Courses of reading, as laid down in text books, are graded for the purpose of meeting the needs of the child; and for supplying reading matter which will be difficult enough to call forth the best thought of the child. In many schools enough reading matter is not furnished to accomplish this purpose. Supplementary reading material is greatly needed, both in city schools and rural schools. A great failing on the part of some reading books is their failure to use the language of every-day things. The child uses words in his speech which he has never seen in books. The reading lesson should not only teach the child new words, but should show him the proper uses of words of every-day life.

FIG. 158.—This rural teacher makes the school garden the basis for much of the other school work, in arithmetic, composition, spelling, etc. (Miss L. Cleaton.)

Suitable reading lessons may be made by using bulletins and books about the garden work. It is as important that the child learn from such sources the right use of the words which are to form a part of his daily vocabulary, as it is that he should extend his vocabulary in learning new words which will seldom be used.

If school gardening is given a place on the program, which to some extent uses the period for reading, that time is more than made up by having the garden class read about the work from any printed matter which is available. The lessons selected from time to time should relate to the work being done in the garden. Soils may be the subject when gardens are first being thought of in early spring. Later on lessons may concern: different kinds of garden plants; planning the garden; implements and garden tools; growth of plants; spraying, and otherwise combating garden enemies; weed problems; methods of harvesting; and preparation for market.

As new words are learned, a little drill should be given from time to time in proper spelling and in their varied uses. Any teacher of reading will readily understand how to make use of the words in the body of a program, as well as those which are placed by the authors of text books at the top of the page. It is more essential that the child know how to properly spell the words which he is to meet in his daily life than that he learn how to spell those words which are seldom found in print.

Geography.—It is now a well-accepted principle that geography should begin at home. Lessons in the new geography are lessons about the products and how people of the world live. Should not the child learn about the things of his own land first? Which is better, for the child to learn how and where bananas are grown, or to learn of the distribution and growth of the American corn crop? There are many valuable garden crops which are used more or less commonly in America, about which many young people know nothing. The study of our own food products is good geography work. No teacher can truthfully say that time spent in the study of garden plants and garden products should better have been spent in the old lines of geography work. We all believe in the newer methods of geography teaching. Nothing is lost by giving a part of the time to the study of gardening, thus reducing the time formerly allowed to the older methods in geography.

The mapping of the school grounds, the drawing of the plans of school gardens and the planning of paths and roads can properly be done during the geography period.

History is too much concerned with rulers, religious strifes and wars between countries. The subject should mean more than that to young people of modern times. Schools prefer to use histories which deal with industries, occupations, inventions, discoveries and the development of things which have had lasting influences upon the advancement of people. It is as important that a child of this century should know of the history of the corn and its development as an American crop and its influence, as to be able to name the battles of the Revolution in the order of their occurrence. It is good history to study the crops which America has added to the staples of the world. Interesting stories regarding the development of several of these crops are found in bulletins, which schools may have for the mere asking. Children in our schools will make better men and women if they learn more about the things which are to be closely associated with their lives. Much of what was formerly found in histories is now being omitted as less vital.

Drawing.—In the best schools much attention is given to expression by means of drawing. This is in perfect accord with modern methods of expression exemplified in books and periodicals. No more satisfactory material can be found for practice in drawing than plants growing in window boxes or in the garden. It is doubtless better to let the child draw from nature than to copy from the work of others. This teaches the proper interpretation of pictures. Appreciation of great works of art comes naturally instead of artificially. Rules of drawing are never so valuable to the child as the drawing itself from natural objects. Teachers in many schools have made the school garden work the basis of the drawing work. Indeed the lovers of drawing have often become the greatest lovers of plants.

New Classes Not Necessary.—Prof. M. A. Leiper, of the Western Kentucky State Normal School, in a paper published by the United States Bureau of Education, says: "The new instruction does not demand new classes; it is to be given, for the most part, in the classes already provided in the present curriculum. . . . The work of adjusting or readjusting the instruction in schools to the needs of children will have to be largely through a reorganization of the subject matter in the old subjects, through a correlation of necessary instruction in nature study, agriculture, and domestic science with that in all the old subjects, and in approaching all subjects from a new and different viewpoint.

"Many of the principles found in the ordinary text books in arithmetic should be omitted and practically all of the problems should be restated. The ideal text for the rural school should emphasize such principles as are needed from time to time in the daily life on the farm and in the farmer's business affairs with the outside world; the problems set for solution should be very practical in nature.

"In physiology and hygiene the rural-school teacher should teach, among other things, the sanitation of the home in regard to pure water supply, cleanliness in dairy, outhouses, back yards, the protection of food from flies, fumigation and disinfection in case of contagious diseases. Instruction should also be given in the causes and method of prevention of tuberculosis, typhoid fever, and other preventable diseases.

"No subject in the public-school curriculum lends itself so easily and effectively to the scheme of correlating with the regular work these practical nature and farm-life subjects as does language work Every child has his language lesson every day throughout the eight years of his public-school life. Subjects for these language lessons must be chosen by the teacher, and they must be closely related to the child's life and interests if the work is to be interesting and effective.

"No better or more attractive source from which these subjects may be chosen can be found than the realms of nature study, agriculture, and domestic science. From these sources most of the subjects for both oral and written language, or composition work, should be drawn. Subjects chosen from these fields are interesting because they are real and vital in the child's life. In talking and writing about the attributes, relations, and activities of objects in the world about him, such as birds, insects, and plants, the child, in addition to gaining valuable information, is adding to his language equipment words that are not meaningless, but words that are really 'signs of ideas.' This can not be the case when subjects foreign to the life and interests of the child are used in language work. Subjects like 'Virtue has its rewards' and 'Honesty is the best policy' are likely to be fatal to interest in composition work.

"Many of the new activities introduced into rural life in connection with agricultural and domestic science offer a great abundance of material for correlation work. Boys' corn clubs and girls' canning clubs afford many desirable subjects, as will be shown later, for narration, description, and exposition. School gardens and experimental plots, as well as experiments in baking bread, or cooking meat, also furnish valuable material for language lessons. The choice of poems to be memorized should be largely those touching nature, while subjects for argument in the language recitation and for debate in the literary society should be taken from nature and rural life."

Prof. Leiper gives some practical suggestions as to the choice of subject matter for oral and written composition under several heads: (1) Conversation exercises; (2) observation reports; (3) narration; (4) essay; (5) description; (6) exposition; (7) memorizing poems and gems of nature; (8) letter writing; (9) argument or debate; (10) verse writing for upper grades; (11) talks from outlines; (12) diary.

For debate the following subjects are suggested:

"Life in country is to be preferred to that of the city."

"Corn is a more profitable crop than cotton (or wheat)."

"Birds are more injurious to farm crops than insects."

"The house fly is more injurious to the human race than smallpox."

"Strawberries are more profitable than the orchard."

CHAPTER XXIII

METHODS OF TEACHING

As many teachers who have not had extended training in garden methods are expected to teach school gardening, or find an opportunity to make use of the garden work in connection with their other school work, a few definite suggestions may be helpful (Fig. 159).

Questions Asked by Children.—Pupils of all ages ask many strange questions. Some of these are easy to answer, while others are very perplexing. Those pupils who have never done any gardening, or whose parents have no home gardens, need the most careful guidance. They will have more puzzling questions to ask, such as "What does that seed look like?" "Do seeds sprout?" "Where do they get the sprout?" "How do plants grow?" "Why do you plant them just so deep?" "Why do you step on the ground over the seeds after planting?" "Why do we scatter the seeds?" "Why do we test the seeds?"

It is not necessary that teachers make scientific answers to all questions asked by children. They should be taught to observe and learn from nature the answers to their own questions. Asking them other questions which will lead them to thinking is better than giving direct answers. Judgment must be used to not stifle thought along lines in which the pupil has become interested. For example, when the question of depth of planting is in the child's mind let an experiment in depth of planting be started, or if it has already been started let him know that the results will be shown a little later. It is well to call his attention to the fact that large seeds are planted deeper than small ones.

Teachers should not fear that questions will be asked which they cannot answer. Such a condition is frequently found in the teaching of any subject, particularly those founded upon nature.

Measuring.—Teach children to be exact. If rows are to be thirty inches apart do not let them add the width of the stake each time. Let the measurement be from, say, the east side of one stake to the east side of the next.

Much benefit may arise in teaching small children to judge with the eye just what is meant by four inches, or any other

FIG. 159.—Teachers in summer school practice gardening so they may teach it better.

definite distance. Measuring sticks should be used for a time. These are made by marking the distances required on laths or other straight pieces of wood. After a little practice with these the child should be taught to judge distance without them while doing the planting of seeds or plants.

Planting.—When it is possible the rows in the garden should run north and south to allow a more even distribution of sunlight about the plants.

The depth in planting seeds depends upon the kind of seed, the size and the condition and character of soil. Small seeds are planted very shallow and large seeds much deeper. Greater depth of planting is practised in sandy soil than in clay soil. When soil is dry the seed must be planted deeper than when it is wet. Such instruction is best given to the children at planting time (Fig. 160).

The term "drill," with reference to method of planting seeds, means the distributing of the seeds in a small mark or furrow. This method may be applied as thin drills and thick

Fig. 160.—Primary pupils planting radish seeds. (Rittenhouse School Gardens.

or close drills. Peas are usually planted in thin drills and lettuce in thick drills.

The term " hills " refers to the planting of seeds in clusters or groups at regular intervals in the garden. Corn is frequently planted in "hills." (See table, Chapter XVIII.)

In the garden work it is better with small children to use vegetables that mature in one season or even in a few weeks. Later on perennials may be used. Quick results are most interesting to small children. Try such crops as lettuce, radish, peas, turnips, onions, beans, early corn, summer squash, tomatoes, and cabbage. It is usually best to omit field crops at first, unless some pedigreed seed is to be tested or some variety new to the region is to be tried.

Thinning.—Children should be shown how to thin plants carefully without disturbing the ones which are to be left in the row. Thinning is frequently necessary, particularly with such plants as beets, because the seeds are in clusters, or many germs are in one seed-case, and several plants sprout so close together that they cannot thrive. Thinning is also necessary when too much seed has been used. Lettuce and radish seeds are planted too thick, with the intention of taking out the largest plants for use and leaving the others thin enough to grow well.

The teacher should show the child which plants are the best to leave, and how to remove other plants with a side motion of the hand. Replacing dirt about the plants to be left is often advisable. If a large area is involved, much of the thinning may be done by the use of a hoe or hand weeder. Plants are left at a given distance apart in bunches, and the fingers may afterward be used in thinning these bunches.

With very small children it is necessary to show which are the good plants and which are the weeds. Close observation may be necessary to discriminate when the plants are small. Radish plants may resemble weeds of the same family.

The position of the child while weeding, or in doing similar work in the garden, is important. If the child supports his weight upon his toes and rests the body upon his heels the position of his back is much better than if he keeps his legs straight and leans over to reach the ground. A very good method is to put one knee on the ground and bend the other leg as just described. The position of the back is then vertical instead of horizontal. (Figs. 159 and 160.)

Using Both Hands.—Children should be taught to use both hands in all garden operations. They may rest the muscles of the hands and arms much better if properly trained in this matter. Weeding and thinning can be done with the left hand as well as with the right. The hand and leg should be used both ways. If the right hand is nearer the tool end they are working right-handed. If the left hand is nearer the tool end they may work left-handed.

Raking.—When raking over the area between two garden rows much soil and other material may accumulate in front of the rake. Instead of this being taken along continuously, it should be pushed back and spread between the rows. If the raking is done well before the garden is planted no material needs to be raked away afterward. The soil should be loosened with the rake and left where it is or nearly so. Teachers need to carefully supervise the raking, as many pupils will rake too lightly and others press too heavily. If clods have formed which accumulate in front of the rake, the motion of the rake may be toward the center of the aisle and then the clods may be crushed there with an upward stroke of the rake, the handle being vertical.

APPENDIX

LITERATURE FOR GARDENERS

United States Farmers' Bulletins.—The list of bulletins of this title includes many subjects of value to gardeners. They will help teachers, and many will be useful in the schools as supplementary readers. Each teacher should write to her congressman at Washington, asking for the number of copies of each bulletin which she is likely to need in the exercises and contests suggested in this circular. Find your congressman's name, and in writing refer to the Farmers' Bulletins by number.

List of Farmers' Bulletins of Help to Gardeners

44—Commercial Fertilizers.
61—Asparagus Culture.
77—Liming of Soils.
121—Beans, Peas, etc., as Food.
154—The Home Fruit Garden.
157—The Propagation of Plants.
181—Pruning.
185—Beautifying the Home Grounds.
188—Weeds in Medicine.
192—Barnyard Manure.
195—Annual Flowering Plants.
196—Usefulness of the American Toad.
198—Strawberries.
204—The Cultivation of Mushrooms.
213—Raspberries.
218—The School Garden.
220—Tomatoes.
232—Okra—Its Culture and Uses.
254—Cucumbers.
255—The Home Vegetable Garden.
257—Soil Fertility.
282—Celery.
289—Beans.
324—Sweet Potatoes.
354—Onion Culture.
406—Soil Conservation.
407—The Potato as a Truck Crop.
428—Testing Seeds.
433—Cabbage.
488—Diseases of Cabbage and Related Crops.
494—Lawns and Lawn Soils.
533—Good Seed Potatoes and How to Produce Them.
537—How to Grow an Acre of Corn.
543—Common White Grubs.
544—Potato-tuber Diseases.
548—Storing and Marketing Sweet Potatoes.
553—Pop Corn.
561—Bean Growing.
583—Common Mole.
586—Preservation of Plant Material for Agriculture.

609—Bird Houses.
617—School Lessons on Corn.
630—Common Useful Birds.
642—Tomato Growing.
643—Blackberry Culture.
647—Home Garden in the South.
648—Control of Root-knot
660—Weeds.
664—Strawberry Growing.
668—Squavs Vine-borer.
703—Parcel Post Marketing.
707—Grading, Packing, Shipping of Canteloupes.
714—Sweet-potato Disease.
750—Roses for the Home.
753—Handling, Grading, and Marketing Potatoes.
766—Common Cabbage Worm.
789—Mushroom Pests.
796—Edible and Poisonous Mushrooms.
818—The Small Home Garden.

Farmers' Bulletins on Home Canning

203—Canned Fruits, Preserves and Jellies.
256—The Preparation of Vegetables for the Table.
359—Canning Vegetables in the Home.
426—Canning Peaches on the Farm.
521—Canning Tomatoes at Home and in Club Work.

Special Circulars on Home Garden Club Work Issued by the Bureau of Plant Industry

104—Special Contests in Corn Club Work.
803—Organization and Instruction in Club Work.
883—Tomato Growing as Club Work.
884—Potato Growing as Club Work.

Helpful Books

Title	Author	Publisher
Manual of Weeds	Georgia	The Macmillan Co.
The New Standard Cyclopedia of Horticulture	Bailey (Ed.)	The Macmillan Co.
Manual of Gardening	Bailey (Ed.)	The Macmillan Co.
Garden Making	Bailey (Ed.)	The Macmillan Co.
The Forcing Book	Bailey (Ed.)	The Macmillan Co.
Principles of Plant Culture	Goff	The Macmillan Co.
Gardening for Pleasure	Henderson	Orange Judd Co.
The Principles of Fruit Growing	Bailey	The Macmillan Co.
The Pruning Book	Bailey	The Macmillan Co.
The Nursery Book	Bailey	The Macmillan Co.
Bush Fruits	Card	The Macmillan Co.
Popular Fruit Growing	Green	Webb. Pub. Co. (St. Paul)
Citrus Fruits and Their Culture	Hume	Orange Judd Co.
The Orchard and Fruit Garden	Powell	Doubleday Page Co.

Title	Author	Publisher
Productive Orcharding	Sears	J. B. Lippincott Co.
The American Apple Orchard	Waugh	Orange Judd Co.
The American Peach Orchard	Waugh	Orange Judd Co.
The Beginners' Guide to Fruit Growing	Waugh	Orange Judd Co.
Fruit Harvesting, Marketing and Storing	Waugh	Orange Judd Co.
Modern Strawberry Growing	Wilkinson	Doubleday Page Co.
Cabbage, Cauliflower and Allied Vegetables	Allen	Orange Judd Co.
The Principles of Vegetable Gardening	Bailey	The Macmillan Co.
The Practical Garden Book	Bailey	The Macmillan Co.
Celery Culture	Beattie	Orange Judd Co.
The Vegetable Garden	Bennett	Doubleday Page Co.
Garden Farming	Corbett	Ginn & Co.
Sweet Potato Culture	Fitz	Orange Judd Co.
How to Grow Vegetables	French	The Macmillan Co.
Beginners' Garden Book	French	The Macmillan Co.
How to Make a Vegetable Garden	Fullerton	Doubleday Page Co.
The New Onion Culture	Greiner	Orange Judd Co.
Vegetable Gardening	Green	Webb Pub. Co. (St. Paul)
The Home Vegetable Garden	Kruhm	Orange Judd Co.
Productive Vegetable Gardening	Lloyd	J. B. Lippincott Co.
The Home Garden	Rexford	J. B. Lippincott Co.
Peas and Pea Culture	Sevey	Orange Judd Co.
Tomato Culture	Troop	Orange Judd Co.
Vegetable Gardening	Watts	Orange Judd Co.
House Plants and How to Grow Them	Barnes	Doubleday Page Co.
Home Floriculture	Rexford	Orange Judd Co.
Landscape Gardening	Waugh	Orange Judd Co.
Studies of Trees	Levison	Jno. Wiley & Sons
School and Home Gardens	Meier	Ginn & Co.
Rural Improvement	Waugh	Orange Judd Co.
Agriculture Through the Laboratory and School Garden	Jackson & Daugherty	Orange Judd Co.
Among School Gardens	Green	School Garden As. of Am.
Principles of Floriculture	White	The Macmillan Co.
Children's Gardens	Parsons	Sturgis & Walton Co.

State Station and Extension Bulletins

Write to your State Agricultural Experiment Station. The addresses of the Stations in different states are as follows:

Alabama, Auburn, Uniontown and Tuskegee Institute.
Alaska, Sitka.
Arizona, Tucson.
Arkansas, Fayetteville.
California, Berkeley.
Colorado, Fort Collins.
Connecticut, New Haven and Storrs.
Delaware, Newark.
Florida, Gainesville.
Georgia, Experiment.
Guam, Island of Guam.
Hawaii, Honolulu.
Idaho, Moscow.
Illinois, Urbana.
Indiana, La Fayette.
Iowa, Ames.
Kansas, Manhattan.
Kentucky, Lexington.
Louisiana, Baton Rogue, Audubon Park, New Orleans and Calhoun.
Maine, Orono.
Maryland, College Park.
Massachusetts, Amherst.
Michigan, East Lansing.
Minnesota, University Farm, St. Paul.
Mississippi, Agricultural College.
Missouri, Columbia, and Mountain Grove.
Montana, Bozeman.
Nebraska, Lincoln.
Nevada, Reno.
New Hampshire, Durham.
New Jersey, New Brunswick.
New Mexico, State College.
New York, Geneva, and Ithaca.
North Carolina, West Raleigh.
North Dakota, Agricultural College.
Ohio, Wooster.
Oklahoma, Stillwater.
Oregon, Corvallis.
Pennsylvania, State College.
Porto Rico, Mayguez.
Rhode Island, Kingston.
South Carolina, Clemson College.
South Dakota, Brookings.
Tennessee, Knoxville.
Texas, College Station.
Utah, Logan.
Vermont, Burlington.
Virginia, Blacksburg, and Norfolk.
Washington, Pullman.
West Virginia, Morgantown.
Wisconsin, Madison.
Wyoming, Laramie.

Information on School Gardens.—The School Garden Association of America, with its headquarters at 124 West 30th St., New York, gathers information, and collects illustrations for use in making lantern slides. It issues an Annual Report helpful to teachers and Club workers. This Association is glad to receive from you pictures, suggestions, courses of study, and other matter relating to school garden work.

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